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STANDARDISED FATIGUE LOADING SEQUENCES FOR HELICOPTER ROTORS (HELIX AND FELIX)

PART 2:

FINAL DEFINITION OF HELIX AND FELIX

Compiled by

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SUMMARY

Helix and Felix are standard loading sequences which relate to the rotors of helicopters with articulated and semi-rigid rotors respectively. The purpose of the loading standards is, first, to provide a convenient tool for providing fatigue data under realistic loading, which can immediately be compared with data obtained by other organisations. Second, loading standards can be used to provide design data. This Report is the second of the two final project reports and gives the final defined form of the two standards both in full length and shortened versions. The method of generation is extremely simple, although a considerable amount of data is required for the generation algorithm. A FORTRAN program is presented for this purpose, together with complete data tables in the correct format.

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1 INTRODUCTION

This Report defines two loading standards for the fatigue evaluation of helicopter rotor materials and components. They were developed as a collaborative study between West Germany, the Netherlands and UK. Details of the contributing organisations are given in Appendix A.

The new loading standards follow the earlier TWIST[1] (Transport WIng STandard), and FALSTAFF[2] (Fighter Aircraft Loading STAndard For Fatigue evaluation). After the tradition of these earlier loading sequences, the new loading standards have been given identifying names. For these the origin of the word helicopter (helix-spiral, pteron-wing from the Greek) has provided a convenient basis. The new standards are called:

> Helix - loading standard for 'hinged' or articulated rotors
> Felix - loading standard for 'fixed' or semi-rigid rotors.

Lower case lettering is adopted because the names Helix and Felix are not acronyms.

This Report defines the final form of the two standards, statistical content according to different counting methods and full details of their method of generation. The background to their definition, a fuller discussion of their statistical content and results of the fatigue tests used to assess them are presented in Ref 3. It should be noted that Ref 3 and this Report constitute the final complete summary of the Helix/Felix Project. They supersede Refs 4 and 5, the earlier Project Reports which defined Helix in what should now be regarded as a provisional form and gave details of ongoing and planned fatigue tests. Additional keywords: algorithms, Fortran program.

The standards are based on measurements of loads taken at the position of maximum flapwise bending moment on the rotor. For the case of the articulated rotors this was at about half rotor radius and on the lower surface of the blade; for the semi-rigid rotors this was at the lower surface of the blade root.

The reason why the original published version of Helix should now be regarded as provisional is that, at a late stage in the Project, a simplification was made to Helix and Felix. The number of defined load levels was reduced to 31 in Helix and 33 in Felix, and the maximum load in each sequence was scaled to 100, where previously it was 74. The differences between the final and original versions of the standards are described in Ref 3. This change was made in order to simplify analysis and generation of the standards, and to provide a more rational basis for plotting test results. Thus the final defined version of Helix described in this Report and in Ref 3 differs in detail from that published in Ref 4. The changes made are small in terms of the predicted effect on fatigue life and should not affect the relevance of the fatigue test results. However the changes are considerable in reducing complication when using the standards, and the earlier versions are now obsolete.

In the assessment[3] of the possible uses of Helix and Felix it was recommended that shortened versions of the two loading standards analogous to the shortened version of the Transport WIng STandard MINITWIST[6], should be used with extreme caution, and then only for long life tests to determine the fatigue limit. Such tests should in any case, be

supplemented by further tests at higher stress levels under the full standard load sequences. The shortened versions of the standards were derived by omitting low level loads, and are termed Helix/32 and Felix/28. Their definition also is given in this Report.

2 DEFINITION OF HELIX AND FELIX

Helicopters are multi-role vehicles and in different roles can experience greatly differing sequences of blade loads. For the purpose of this study a sortie was defined as a flight fulfilling a particular role, and a flight as the period between take-off and subsequent landing. It was assumed that at every landing the rotor came to a complete stop so that every air-ground-air cycle was a start-stop-start cycle. Helix and Felix consist of the same sequence of 140 sorties representing 190.5 hours of flight. Each sortie in the sequence represents one of either Training, Transport, Anti-Submarine Warfare (ASW), or Search And Rescue (SAR). Each of these appear in the sequence in three different lengths.

Each sortie consists of a sequence of manoeuvres, which is the same every time a particular type of sortie with the same length is applied. Helix and Felix each have their own set of manoeuvres which are placed in sequence in order to define the sorties. The manoeuvres are similar for Helix and Felix, but are not always directly equivalent. For this reason the sequences of the manoeuvres making up any sortie are similar but not identical for Helix and Felix. When any manoeuvre is applied on different occasions the sequence of loads is always the same.

The following sections 2.1 to 2.3 describe the component parts of Helix and Felix in detail. Details of their derivation can be found in Ref 3.

2.1 Sequence of sorties

The 140 flight sequence of sorties applying to both Helix and Felix is shown in Table 1 and was chosen on the basis of a once-and-for-all random draw. As can be seen each sortie is defined in three lengths, 0.75 hour, 2.25 hours and 3.75 hours. Table 2 shows the numbers of sorties of each length in the sequence.

2.2 Definition of manoeuvres

As described in Ref 3, before the sequence of manoeuvres for each sortie could be defined it was necessary to define individual manoeuvres for each class of helicopter. Helix was based on data obtained from the Sea King and Felix on data from the BO-105.

Data available for the Sea King and BO-105 identified 24 and 22 manoeuvres respectively, which were to be placed in sequence in the subsequent definition of the sorties. These were all non-dimensionalised to express the loads or strains on a scale up to 100 in intervals of 4. This scale was deemed to be in 'Helix units' or 'Felix units'. As originally defined Helix[4] and Felix units were on scales up to 74 and had a greater number of defined levels than in the final versions. The differences between the original and, as described here, final versions of the standards are described in Ref 3.

Tables 3 and 4 list the defined manoeuvres in Helix and Felix respectively. Shown also is the loading content of each manoeuvre expressed in Helix/Felix units. Each

manoeuvre is applied at its own characteristic mean stress value, with each cycle applied as a full cycle, as described in section 2.3 below. As can be seen the definitions of the manoeuvres are similar, but not identical, for the two classes of helicopter. For instance Helix has two manoeuvres, 8 and 9, describing approach to hover, whereas Felix has only one. These differences reflect the different sources of data and different definitions of what at first sight may appear to be the same manoeuvres. These inconsistencies between the two sets of data led, as shown below, to manoeuvre sequences in each sortie which differed in the two standards.

For both standards, as for virtually all laboratory loading sequences, an alternating level was selected below which cycles were not included. As can be seen from Tables 3 and 4, the lowest amplitudes included were 20 and 16 for Helix and Felix respectively. The levels of omission from the spectra were slightly below these levels which represented a band of cycles extending both above and below the defined values. It can be seen from Tables 3 and 4 that the omission of the low level cycles resulted in some manoeuvres having no significant loads. For completeness these manoeuvres were included in the standards but no loads or dwells are applied. Omission of levels from Helix and Felix is discussed further in section 2.7.

2.3 Sequence of loads in a manoeuvre

The sequence of loads in any manoeuvre was chosen for both standards on the basis of a once-and-for-all random draw. Therefore, every time a particular manoeuvre is performed the sequence of loads is the same. Tables 5 and 6 show all the defined manoeuvres in Helix and Felix respectively. The numbers are all in Helix/Felix units. In each case the first number is the mean stress. The subsequent numbers represent complete alternating cycles going positive first. Details of the transitions between flights and transitions between manoeuvres are given in section 2.6 below. Many of the cycles have to be repeated several times in order to carry out their function fully, or to account fully for the time spent in that manoeuvre (*eg* forward flight).

2.4 Sequence and mix of manoeuvres in a sortie

The lack of operational statistics describing manoeuvre sequences led to their synthesis by common sense consideration of the flight profile and the objective of the sortie. In the simplest case the above approach says, for instance, that a helicopter cannot perform a bank turn without first taking off. Tables 7 to 10 give for Helix the sequence of manoeuvres for the 3.75 hours Training, Transport, ASW and SAR sorties respectively. Table 11 gives the content of the ASW combined manoeuvre described in (c) below. Tables 12 to 16 give the corresponding information for Felix. Definition of the shorter length sorties is described in section 2.5 below. The original intention was to use the same sequence of manoeuvres for Helix as Felix. However, in practice it was found that the defined manoeuvres were not always directly equivalent between Helix and Felix, and so could not always be sequenced in the same way. Therefore the sequences for Helix were derived first, and those for Felix formulated to be as similar as possible. Table 17 shows the equivalence assumed for manoeuvres in Helix and Felix. The considerations taken into account when synthesising the four sortie sequences were as follows.

(a) Training (Tables 7 and 12)

This was the most difficult sortie to define because of the wide ranging operations that are flown. The assumption was made, however, that this sortie should simulate the essential aspects of flight needed to perform other sorties. In addition a pure training exercise was simulated in which the helicopter performs manoeuvres to demonstrate handling characteristics. Fig 1 shows a trace of the first six manoeuvres of those in Table 7 for the Training sortie for Helix. Note that in Table 7 the column 'Matrix applications' refers to the number of times that the defined sequence of loads has to be repeated in order to describe fully the manoeuvre.

(b) Transport (Tables 8 and 13)

This sortie represents take-off and low speed manoeuvres away from the terminal area, flight at cruising speed whilst manoeuvring to take into account terrain and air traffic control restrictions, and finally landing in the terminal area.

(c) ASW (Tables 9 and 14)

In this sortie, apart from the requirement to move to and from the base area, the helicopter repeatedly decelerates to allow deployment of a sonar buoy, and accelerates to move to a new search area. A unique feature of this sortie was the use of the 'Combined Manoeuvre' simulating sonar dunks. The Combined Manoeuvres are defined in Tables 11 and 17 for Helix and Felix respectively and are referred to in Tables 9 and 14 as manoeuvre 25. The application of the Combined Manoeuvre for each of the 14 sonar dunks in the ASW sortie, instead of defining it 14 times as separate sequences of 16 manoeuvres for Helix and 11 for Felix, led to a considerable reduction in the data defining that sortie.

(d) SAR (Tables 10 and 15)

The essential part of this sortie is the flying of low speed manoeuvres in order to execute a rescue.

2.5 Variation in lengths of sorties

The 0.75 hour and 2.25 hour flights were defined as fractions of the full 3.75 hour sorties. Thus only one sequence of manoeuvres was defined for each sortie, the whole of which is used for the 3.75 hour flight. For the flights of 0.75 hour and 2.25 hours, take-off and landing are applied as for the complete sortie but a selected part or parts is cut out from the rest of the flight. Fig 2 shows how this is done for the Training, Transport and ASW sorties.

Fig 2a shows an altitude profile for a 3.75 hour flight. If a 2.25 hour flight is to be generated, the loading sequence is applied as before up to the point marked '2.25 hour flight marker'. Then a jump is made to the point marked 'Landing marker' and the sequence is continued to conclusion from this point. The resulting altitude profile is shown in Fig 2b. If a 0.75 hour flight is to be generated then the procedure is identical except for the fact that the 0.75 hour marker is used instead of the 2.25 hour marker. The altitude profile for the 0.75 hour flight is shown in Fig 2c.

The procedure for the SAR sortie is slightly more complicated and is described in Fig 3. In this the prime consideration is to ensure that the lengths of the flights to and from the rescue area are related in a logical way. Fig 3a shows the altitude profile for a 3.75 hour SAR flight. For a 2.25 hour flight a jump is made from the 'First 2.25 hour flight marker' to the 'SAR marker'. Generation continues up to the 'Second 2.25 hour marker', a jump is made to the 'SAR marker', and landing occurs as before. Fig 3b shows the resulting altitude profile. Fig 3c shows the altitude profile for a 0.75 hour flight, which uses the markers for 0.75 hour instead of those for 2.25 hours.

2.6 Transitions between manoeuvres, and magnitudes of ground loads

Two final pieces of information are needed to complete the definition of Helix and Felix. First is the detail of how to make transitions between manoeuvres, and second how to deal with transitions between flights. These are shown in Fig 4, which gives the transition between landing and take-off for Helix. All manoeuvres, as stated earlier, consist of a constant mean stress, which, as can be seen from Fig 4, is 72 Helix units. Each cycle starts going positive so the first turning point reached by the landing manoeuvre is at 72 + 28 = 100 Helix units. It then reverses and reaches its second turning point at 72 - 28 = 44 Helix units. The cycle is completed by returning to the mean value. Each subsequent cycle starts and finishes in exactly the same way, and the last half cycle in the meanoeuvre must return to the mean stress before, either, a transition is made down to the landing load, as at the end of the landing manoeuvre in Fig 4, where the rotor is assumed to stop, or a transition is made to the next mean stress. This means that, in the transition from one manoeuvre to another, if the mean stress increases between manoeuvres then the load progresses smoothly from the last half cycle of the first manoeuvre to the first half cycle of the second manoeuvre. This is illustrated in Fig 4 by the dotted transition following the take-off loads. If, on the other hand, the mean stress decreases from manoeuvre to manoeuvre then an extra small cycle is introduced between manoeuvres by the return to the mean at the end of the first manoeuvre. This is illustrated by the full line transition following the take-off.

The measured values used for the ground load transitions are -20 for Helix and -28 for Felix, both values being in Helix/Felix units.

2.7 Shortened versions of Helix and Felix

In Ref 3 it was recommended that Helix and Felix should be used in shortened forms with extreme caution, and then only when testing at long lives close to the fatigue limit. When this is done further tests under the full sequences should be carried out at higher stress levels. This section describes the method of omission of low level cycles in order to obtain the shortened sequences. Section 3.6 describes rainflow analyses of the shortened sequences.

The method of omission of cycles is to choose a manoeuvre alternating stress level at and below which cycles are omitted. However if this is applied rigorously some manoeuvres disappear altogether. In order to retain the identity of such manoeuvres one alternating cycle is applied at the highest level contained in that manoeuvre. This level

is, of course, at or below the nominal level of omission. Additionally some low level cycles occur in the transition from one manoeuvre to another, as described in section 2.6. These low level cycles are retained.

The levels of omission chosen for normal use were 32 for Helix and 28 for Felix, giving defined sequences known as Helix/32 and Felix/28. The sequences are generated in exactly the same way as for the full versions except that the defined loads for each manoeuvre are modified. Table 18 gives the modified load sequences used for the Helix/32 manoeuvres, and Table 19 gives those for Felix/28. Lengths of the full and modified sequences are given in Table 20.

3 STATISTICS OF HELIX AND FELIX

In this section are presented the most important statistics, from the point of view of fatigue, of the two standards. These are also presented in Ref 3 and are discussed in more detail there.

3.1 Comparison of Helix and Felix spectra

Helix and Felix were analysed by more than one counting method, and the results of these are shown in Tables 21 to 24. Tables 21 and 23 give the results of the rainflow analyses, and Tables 22 and 24 give analyses of peak, trough and levels crossed distributions.

Fig 5 shows a comparison of Helix and Felix spectra using the data obtained from rainflow counting, in which mean stresses have been ignored to ease the comparison. The air-ground-air transitions, as can be seen, give large steps in both Helix and Felix at the top end of the spectra, which tend to mask the differences in the flight load distributions for the two standards. However it should be appreciated that the steps are associated with extra loads on the negative side only. It can be seen that there is a marked difference in the shapes of the spectra for the flight loads, with the spectrum for Helix being generally flatter than that for Felix outside the region affected by the air-ground-air transitions.

The differences between the spectra for Helix and Felix are illustrated further in Fig 6 which compares the two on the basis of positive-going levels crossed. Here the differences are more obvious at the high stress end than in the previous figure, because the air-ground-air transitions only affect this plot at the negative stresses. At stresses above 60 Helix/Felix units a much sharper truncation for Helix than Felix can be seen. Also evident from Fig 6 is that both the top and bottom lines of the Felix spectrum are generally below those for Helix, although the maximum loads have been scaled to be the same in both cases. This indicates a generally lower relative level of mean load for Felix than Helix.

3.2 Spectra for Helix and Felix with levels omitted

Rainflow analyses were carried out on Helix/32 and Felix/28, and the results are presented in Tables 25(a) and 26(a) respectively. Tables 25(b) and 26(b) give information on peak and trough counts. The spectra for the short and long versions of the two standards are compared in Fig 7 for Helix and Fig 8 for Felix. As can be seen the two

short sequences are less than a tenth of the length of the full versions. The actual lengths of the shortened sequences are given in Table 20.

4 GENERATING HELIX AND FELIX

As can be seen from section 3 the system for generating Helix and Felix is extremely simple. Both standards consist of a predetermined sequence of sorties, which represent Training, Transport, ASW and SAR in three different lengths. Each sortie consists of a predetermined sequence of manoeuvres, which in turn consist of predetermined sequences of loads. Sorties having lengths of 0.75 hour and 2.25 hours are derived by taking selected parts of the full length 3.75 hour sorties.

Appendix B lists a FORTRAN program which can be used to generate both standards in the full and shortened forms, Helix/32 and Felix/28 with different sets of data. Data to generate all the variants of the two standards are given in Tables 28 to 36. The key to this data is given in Fig 27 which lists in order the tables containing the appropriate data for generating each variant of the standards. Data is input from one channel and each set of data consists of four parts, with each part taken from one table with all the comments removed and the data closed up vertically.

Each set of data must consist of one of each of the following components; sequence of sorties, sequence of manoeuvres in the sorties, sequence of manoeuvres in the ASW combined manoeuvre, and finally the content of the manoeuvres.

The program, details of which are given below, consists of four segments. First is the segment which reads in the data. The second segment outputs all the data in a form which describes their function. This second segment is intended as a data check and can be omitted if desired, as described in the comments in the program. The third carried out the generation, outputting to a separate channel, and finally the fourth segment prints out an analysis of the number of peaks and troughs generated at the different levels. This output may be compared with the appropriate parts of Tables 22, 24, 25(b) and 26(b) so as to check that generation has been carried out correctly. Appendix C gives sample outputs of the generation program. Appendix D gives more details of the main generation algorithm with flow charts.

The contributing Organisations are willing to provide any help or information necessary for the implementation of Helix, Felix and their variants. This includes the supply of the generating programs or sequences on magnetic tape or other media.

Appendix A

CONTRIBUTING ORGANISATIONS, AND ACKNOWLEDGMENTS

A.1 Organisations

LBF : Fraunhofer-Institute für Betriebsfestigkeit

LBF,
Bartningstrasse 47,
D-6100 Darmstadt-Kranichstein,
West Germany.

IABG : Industrieanlagen-Betriebsgesellschaft mbH,
Einsteinstrasse 20,
8012 Ottobrun bei München
West Germany.

MBB : Messerschmitt-Bölkow-Blohm GmbH,
Postfach 801140,
8000 München 80,
West Germany.

NLR : Nationaal Lucht-en Ruimtevaartlaboratorium,
Voorsterweg 31,
8316 PR Markness E,
NOP,
The Netherlands.

RAE : Royal Aircraft Establishment,
Farnborough,
Hampshire,
GU14 6TD,
United Kingdom.

A.2 Acknowledgments

The support of Westland Helicopters Ltd, to this project, particularly Mr A.D. Hall and Mr D. Boocock, is gratefully acknowledged.

Appendix B

FORTRAN PROGRAM TO GENERATE HELIX, FELIX AND THEIR VARIANTS

```
      PROGRAM HIXFIX
      DIMENSION ISEQ(140),NMS(4),MTYPE(360,4),NOMA(360,4),
     /IASWTY(16),MASW(16),NLM(24),LSM(75,24),NEWN(5),
     /LEVEL(148),IBUF(33),JBUF(33)
      CHARACTER*8 ISPEC
      OPEN(2,FILE='HSEQ',STATUS='NEW')
      OPEN(1,FILE='HDAT',STATUS='OLD')
      OPEN(3,FILE='HFOUT',STATUS='NEW')
C
C
C     ----- GENERAL COMMENTS: -----
C
C     ---  THIS FORTRAN PROGRAM GENERATES THE HELICOPTER SEQUENCE
C     ---  HELIX,HELIX/32,FELIX OR FELIX/28 DEPENDING UPON THE DATA
C     ---  STORED IN THE INPUT FILE, DEFINED IN THIS LISTING AS 'HDAT'.
C     ---  THE NAME OF THE SEQUENCE IS SPECIFIED AT THE BEGINNING
C     ---  OF THE INPUT DATA AS CHARACTER VARIABLE 'ISPEC'. THIS
C     ---  DOES NOT AFFECT THE GENERATION ALGORITHM, BUT GENERATES
C     ---  APPROPRIATE REFERENCES IN THE PRINTOUT.
C     ---
C     ---  THE SUBSEQUENT LOAD-LEVELS GENERATED IN THIS PROGRAM ARE
C     ---  WRITTEN TO FILE 'HSEQ', WHICH BEING RATHER LONG, IS PROBABLY
C     ---  BEST DEFINED AS A MAGNETIC TAPE FILE. NOTE THAT OUTPUT TO
C     ---  THIS FILE IS DISABLED BY COMMENT MARKERS IN THIS LISTING.
C     ---
C     ---  THE ARRAY 'LEVEL(148)' IS ONLY USED AS AN INTERMEDIATE
C     ---  STATION TO STORE ALL LOAD  LEVELS WITHIN ONE MANOEUVRE,
C     ---  WHICH MAY BE USEFUL IN SOME CASES.
C     ---
C     ---  ANY USER OF THIS PROGRAM MAY BE FORCED TO MODIFY THE
C     ---  PRECISE INPUT PROCEDURES BUT THIS DOES NOT AFFECT
C     ---  THE GENERATION ALGORITHM.
C     ---  THIS ALSO APPLIES TO THE OUTPUT PROCEDURES WHICH ARE
C     ---  NECESSARY FOR CHECKING PURPOSES ONLY.THEY MAY BE LEFT
C     ---  OUT WHENEVER WISHED ('GOTO'-STATEMENT,SEE BELOW).
C     ---
C     ---  THE INPUT DATA HAVE BEEN DIVIDED INTO FOUR STAGES OR
C     ---  'POSITIONS' TO EASE CHECKING (SEE TABLE HEADINGS).
C     ---  FOR EXAMPLE: GENERATION OF FELIX/28 INSTEAD OF HELIX
C     ---  IS DONE BY SUBSTITUTION OF THE HELIX DATA FILE BY ANOTHER
C     ---  CONTAINING THE APPROPRIATE FELIX/28 TABLES.
C     ---  FOR A DESCRIPTION OF THE NECESSARY INPUT TABLES AND
C     ---  THEIR CONTENTS SEE THE RELATED PARTS IN THE REPORT:
C     ---  'STANDARDISED FATIGUE LOADING SEQUENCES FOR HELICOPTER
C     ---   ROTORS (HELIX AND FELIX);PART 2:FINAL DEFINITION OF
C     ---   HELIX AND FELIX'.
C     ---
C     ---  DESCRIPTION OF VARIABLES:
C     ---     ISEQ     = SEQUENCE OF 140 SORTIES THAT DEFINE
C     ---                HELIX AND FELIX
```

```
C      ---      ISORTE    = TYPE OF SORTIE
C      ---      ISPEC     = CHARACTER VARIABLE - NAME OF THE SEQUENCE
C      ---      NMS       = NUMBER OF MANOEUVRES IN EACH OF THE
C      ---                  FOUR SORTIES
C      ---      MTYPE     = THE TYPE AND SEQUENCE OF MANOEUVRES
C      ---                  IN EACH SORTIE
C      ---      NOMA      = NUMBER OF MATRIX APPLICATIONS REQUIRED
C      ---                  FOR THE MANOEUVRES IN EACH SORTIE
C      ---      KASW      = NUMBER OF MANOEUVRES IN ASW SORTIE
C      ---      IASWTY    = TYPE AND SEQUENCE OF MANOEUVRES IN
C      ---                  STANDARD SONAR DUNK OPERATION IN
C      ---                  ASW SORTIE
C      ---      MASW      = NUMBER OF MATRIX APPLICATIONS FOR ABOVE
C      ---      NEWN      = MANOEUVRE SEQUENCE NUMBER IN EACH SORTIE
C      ---                  THAT STARTS THE END OF FLIGHT SEQUENCE OF
C      ---                  MANOEUVRES AND FOR SAR THE MANOEUVRE SEQUENCE
C      ---                  NUMBER THAT STARTS THE STANDARD RESCUE
C      ---                  SEQUENCE OF MANOEUVRES
C      ---      NLM       = NUMBER OF LOADS IN EACH OF THE 24 STANDARD
C      ---                  MANOEUVRES (22 FOR FELIX)
C      ---      LSM       = SEQUENCE OF LOADS IN EACH OF THE 24 STANDARD
C      ---                  MANOEUVRES
C      ---      NS        = NUMBER OF SORTIES TO BE GENERATED
C      ---      LOADG     = GROUND LOAD VALUE (-20 FOR HELIX,-28 FOR FELIX)
C      ---      LEVEL(I) = ARRAY HOLDING ALL LOADS WITHIN ONE MANOEUVRE
C      ---      IBUF,JBUF= ARRAYS THAT SPECIFY NUMBER OF TIMES EACH
C      ---                  PEAK- AND TROUGH-VALUE HAS BEEN GENERATED
C
C      INITIALISATION OF THE MATRICES:
       DO 500,I=1,360
       DO 500,J=1,4
       MTYPE(I,J)=0
500    NOMA(I,J)=0
       DO 510 I=1,75
       DO 510 J=1,24
510    LSM(I,J)=0
       DO 520 I=1,16
       IASWTY(I)=0
520    MASW(I)=0
       DO 530 I=1,148
530    LEVEL(I)=0
       DO 540 I=1,33
       IBUF(I)=0
540    JBUF(I)=0
C
C      **************
C      INPUT OF DATA:
C      **************
       READ(1,*)ISPEC
       READ(1,*)NS
       READ(1,*)(ISEQ(I),I=1,NS)
       READ(1,*)I
       IF(I.NE.919) STOP 'INPUT ERROR POSITION 1'
       READ(1,*)(NMS(I),I=1,4)
```

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```
      READ(1,*)(NEWN(I),I=1,5)
      DO 10 K=1,4
      J=NMS(K)
10    READ(1,*)(MTYPE(I,K),NOMA(I,K),I=1,J)
      READ(1,*)I
      IF(I.NE.929) STOP 'INPUT ERROR POSITION 2'
      READ(1,*)KASW
      READ(1,*)(IASWTY(I),I=1,KASW)
      READ(1,*)(MASW(I),I=1,KASW)
      READ(1,*)I
      IF(I.NE.939) STOP 'INPUT ERROR POSITION 3'
      READ(1,*)(NLM(I),I=1,24)
      DO 40 K=1,24
      IF(NLM(K)) 30,40,30
30    J=NLM(K)
      READ(1,*)(LSM(I,K),I=1,J)
40    CONTINUE
      READ(1,*)LOADG
      READ(1,*)I
      IF(I.NE.949) STOP 'INPUT ERROR POSITION 4'
C
C
C     ****************
C     OUTPUT OF DATA:
C     ****************
      WRITE(3,1002)ISPEC
1002  FORMAT(///1X,39HHELICOPTER SEQUENCE TO BE GENERATED IS ,A8/)
C
C     IN ORDER TO CANCEL LISTINGS OF MAJOR TABLES TO FILE 'HFOUT'
C     ENTER *GOTO 150* AT THIS LOCATION:
C     GOTO 150
C
      WRITE(3,1003)LOADG
1003  FORMAT(/,6X,15HGROUND LOAD IS:,I4,/,6X,
     /30HKEY:-20 FOR HELIX AND HELIX/32,/,10X,
     /26H-28 FOR FELIX AND FELIX/28,/)
      WRITE(3,1004)
      WRITE(3,1005)(ISEQ(I),I=1,140)
1004  FORMAT(/,6X,23HKEY TO SORTIE SEQUENCE:,/,21X,12HTRAINING =10,/
     /,20X,13HTRANSPORT =20,/,26X,7HASW =30,/,26X,7HSAR =40,//,15X,
     /18H0.75 HR FLIGHT = 1,/,15X,18H2.25 HR FLIGHT = 2,/,15X,
     /18H3.75 HR FLIGHT = 3,//,6X,13H**  EXAMPLE: ,
     /36H23 IS A 3.75 HR TRANSPORT FLIGHT  **,//,1X,
     /16HSORTIE SEQUENCE:,/)
1005  FORMAT(20I4)
C     SEQUENCE OF MANOEUVRES IN EACH SORTIE
      WRITE(3,1006)
      K=NMS(3)
      DO 110 I=1,K
      IF(I-NMS(4)-1) 50,60,60
50    WRITE(3,1007) (I,MTYPE(I,ISORTE),NOMA(I,ISORTE),ISORTE=1,4,1)
      GOTO 110
60    IF(I-NMS(2)-1) 70,80,80
70    WRITE(3,1008)(I,MTYPE(I,ISORTE),NOMA(I,ISORTE),ISORTE=1,3,1)
```

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```
      GOTO 110
80    IF(I-NMS(1)-1) 90,100,100
90    WRITE(3,1009)(I,MTYPE(I,ISORTE),NOMA(I,ISORTE),ISORTE=1,3,2)
      GOTO 110
100   WRITE(3,1010)(I,MTYPE(I,ISORTE),NOMA(I,ISORTE),ISORTE=3,3,1)
110   CONTINUE
1006  FORMAT(///,20X,35H* MANOEUVRE SEQUENCES FOR SORTIES *,//,1X,
     /17HSORTIE 1-TRAINING,3X,18HSORTIE 2-TRANSPORT,5X,12HSORTIE 3-ASW
     /,8X,12HSORTIE 4-SAR,//,1X,4(1X,19HNO. MAN. REPEATS   ),/)
1007  FORMAT(4(1X,I3,3X,I2,3X,I3,5X))
1008  FORMAT(3(1X,I3,3X,I2,3X,I3,5X))
1009  FORMAT(2(1X,I3,3X,I2,3X,I3,25X))
1010  FORMAT(41X,I3,3X,I2,3X,I3)
C     SEQUENCE OF MANOEUVRES IN STANDARD SONAR DUNK OPERATION
      WRITE(3,1011)ISPEC
      WRITE(3,1024)
      WRITE(3,1012)(I,IASWTY(I),MASW(I),I=1,KASW)
1011  FORMAT(///,4X,
     /57H* MANOEUVRE SEQUENCE FOR STANDARD SONAR DUNK OPERATION - ,8A)
1024  FORMAT(//,4X,25HNUMBER  MAN-TYPE  REPEATS,/)
1012  FORMAT(5X,I3,7X,I2,7X,I3)
C     SUPPLEMENTARY INFORMATION
      WRITE(3,1013)
      WRITE(3,1014)NEWN(1),NEWN(2),NEWN(3),NEWN(5),NEWN(4)
1013  FORMAT(///,4X,30H* SUPPLEMENTARY INFORMATION * ,//,10X,69H1:   MAN
     /-TYPE  -1 AND -2  INDICATE 0.75 HR AND 2.25 HR FLIGHT MARKERS,//,1
     /0X,50H2:   MAN-TYPE  25 IS STANDARD SONAR DUNK OPERATION)
1014  FORMAT(/,10X,44H3:   ENDS OF FLIGHTS START AT MANOEUVRE NO  ,I3,1X
     /,12HFOR TRAINING,/,54X,I3,14H FOR TRANSPORT,/,54X,I3,8H FOR ASW,/,
     /54X,I3,8H FOR SAR,//,10X,43H4:  STANDARD RESCUE STARTS AT MANOEUVR
     /E NO ,I3,14H IN SAR SORTIE)
C     SEQUENCE OF LOADS IN MANOEUVRES
      WRITE(3,1015)ISPEC
      WRITE(3,1025)
      DO 140 I=1,24
      IF(I.GE.23.AND.NLM(I).EQ.0) GOTO 150
      WRITE(3,1016)I
      IF(NLM(I))130,120,130
120   WRITE(3,1017)
      GOTO 140
130   K=NLM(I)
      WRITE(3,1018)(LSM(J,I),J=1,K)
140   CONTINUE
1015  FORMAT(////,4X,37H* LOAD SEQUENCE FOR EACH MANOEUVRE - ,8A)
1025  FORMAT(//,6X,5HMANNO,6X,13HLOAD SEQUENCE,10X,30HNOTE:FIRST
     /ELEMENT IN SEQUENCE,/,45X,34HIS THE MEAN LOAD FOR THE MANOEUVRE)
1016  FORMAT(//,5X,1H*,I4,2X,1H*)
1017  FORMAT(15X,20HNO SIGNIFICANT LOADS)
1018  FORMAT(15X,16I4)
150   CONTINUE
C
C     ******************************
C     START OF GENERATION ALGORITHM:
C     ******************************
```

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```
      FTIME=0.0
C     THE SEQUENCE STARTS WITH A GROUND LOAD:
C     WRITE(2,1027)LOADG
      KK=LOADG/4+8
      JBUF(KK)=JBUF(KK)+1
      DO 360 ICOUNT=1,NS
      N=0
      ISARJ=0
      MEAN=0
      ISORTE=ISEQ(ICOUNT)/10
      FTIME=FTIME+0.75+1.5*(ISEQ(ICOUNT)-ISORTE*10-1)
160   N=N+1
170   MANNO=MTYPE(N,ISORTE)
C
C     CHECK 1:
      IF(ISEQ(ICOUNT)-ISORTE*10+MANNO) 210,180,210
180   N=NEWN(ISORTE+ISARJ)
      IF(ISORTE-4) 170,190,170
190   ISARJ=ISARJ+1
      IF(ISARJ-2) 170,200,170
200   ISARJ=0
      GOTO 170
210   IF(MANNO) 160,220,220
C
C     CHECK 2:
220   IF(MANNO-25) 290,230,290
230   DO 280 NASW=1,KASW
      MANNO=IASWTY(NASW)
C     CHECK 3 IN ASW MISSION:
      IF(NLM(MANNO)) 240,280,240
C     ---- GENERATION OF LOADS (COMBINED MANOEUVRE IN ASW-SORTIE):
240   IF(LSM(1,MANNO).GE.MEAN) GOTO 250
C     GENERATE EXTRA CYCLE:
C     WRITE(2,1023) MEAN
      KK=MEAN/4+8
      IBUF(KK)=IBUF(KK)+1
C     WRITE(2,1023) LSM(1,MANNO)
      KK=LSM(1,MANNO)/4+8
      JBUF(KK)=JBUF(KK)+1
250   NUM1=MASW(NASW)
      DO 270 JJ=1,NUM1
      NUM2=NLM(MANNO)
      DO 260 J=2,NUM2
      LEVEL(2*J-3)=LSM(1,MANNO)+LSM(J,MANNO)
      IF(LEVEL(2*J-3)-100) 420,430,420
C420   WRITE(2,1023) LEVEL(2*J-3)
      GOTO 440
C430   WRITE(2,1027) LEVEL(2*J-3)
440   KK=LEVEL(2*J-3)/4+8
      IBUF(KK)=IBUF(KK)+1
      LEVEL(2*J-2)=LSM(1,MANNO)-LSM(J,MANNO)
C     WRITE(2,1027) LEVEL(2*J-2)
      KK=LEVEL(2*J-2)/4+8
      JBUF(KK)=JBUF(KK)+1
```

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```
260   CONTINUE
270   CONTINUE
C     ---- END OF ASW-LOADS
      MEAN=LSM(1,MANNO)
280   CONTINUE
      GOTO 340
C
C     CHECK 3:
290   IF(NLM(MANNO)) 300,340,300
C
C     ---- GENERATION OF LOADS (ALL OTHER MANOEUVRES):
300   IF(LSM(1,MANNO).GE.MEAN) GOTO 310
C     GENERATE EXTRA CYCLE:
C     WRITE(2,1023) MEAN
      KK=MEAN/4+8
      IBUF(KK)=IBUF(KK)+1
C     WRITE(2,1023) LSM(1,MANNO)
      KK=LSM(1,MANNO)/4+8
      JBUF(KK)=JBUF(KK)+1
310   NUM1=NOMA(N,ISORTE)
      DO 330 JJ=1,NUM1
      NUM2=NLM(MANNO)
      DO 320 J=2,NUM2
      LEVEL(2*J-3)=LSM(1,MANNO)+LSM(J,MANNO)
      IF(LEVEL(2*J-3)-100) 370,380,370
C370   WRITE(2,1023) LEVEL(2*J-3)
      GOTO 390
C380   WRITE(2,1027) LEVEL(2*J-3)
390   KK=LEVEL(2*J-3)/4+8
      IBUF(KK)=IBUF(KK)+1
      LEVEL(2*J-2)=LSM(1,MANNO)-LSM(J,MANNO)
C     WRITE(2,1027) LEVEL(2*J-2)
      KK=LEVEL(2*J-2)/4+8
      JBUF(KK)=JBUF(KK)+1
320   CONTINUE
C     COMPLETE MANOEUVRE CONTENT CAN NOW BE PRINTED
C     USING  ---  LEVEL(K) WITH K=1,(J-2)*2 ---
330   CONTINUE
C     ---- END OF LOADS
      MEAN=LSM(1,MANNO)
340   IF(N-NMS(ISORTE)) 160,350,350
350   CONTINUE
C     ---- TWO FINAL LOADS AT END TO COMPLETE THE SORTIE
C     ---- BUT THE LAST GROUND LOAD AT THE END OF THE LAST SORTIE
C     ---- IS OMITTED BECAUSE IT IS THE SAME AS THE FIRST GROUND LOAD.
C     WRITE(2,1023) MEAN
      KK=MEAN/4+8
      IBUF(KK)=IBUF(KK)+1
      IF(ICOUNT-NS) 400,410,400
C400   WRITE(2,1027) LOADG
      KK=LOADG/4+8
      JBUF(KK)=JBUF(KK)+1
410   PRINT*,ICOUNT
C     ---- THE PRINTING OF 'ICOUNT' GIVES THE OPERATOR A MEANS
```

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```
C      ---- OF PROGRESSING THE ALGORITHM - WHEN ICOUNT=140 THEN
C      ---- THE END HAS BEEN REACHED
360    CONTINUE
C      ***************************
C      END OF GENERATION ALGORITHM
C      ***************************
C
C
C      OUTPUT OF FINAL DATA:
       WRITE(3,1019) NS,FTIME
1019   FORMAT(1X,I3,18H SORTIES COMPLETED,/,
      /1X,18HTOTAL FLIGHT-TIME:,F6.1,5H HOUR,//)
       WRITE(3,1020)ISPEC
       WRITE(3,1026)
1020   FORMAT(/,1X,40HSURVEY OF GENERATED PEAKS AND TROUGHS - ,8A)
1026   FORMAT(1X,6HLEVEL:,8X,9HNUMBER OF,3X,9HNUMBER OF,/,15X,6HPEAKS:,
      /6X,8HTROUGHS:,/)
       WRITE(3,1021)(4*(I-8),IBUF(I),JBUF(I),I=1,33)
1021   FORMAT(1X,I4,3H:   ,5X,I8,5X,I8)
       WRITE(3,1022)
1022   FORMAT(///,1X,25HGENERATION PROGRAM READY.,//)
1023   FORMAT(I2)
1027   FORMAT(I3)
       END
```

Appendix C

SAMPLE OUTPUT OF PROGRAM TO FILE 'HFOUT', REFERRING IN THIS CASE TO FELIX/28

```
HELICOPTER SEQUENCE TO BE GENERATED IS FELIX/28

     GROUND LOAD IS: -28
     KEY:-20 FOR HELIX AND HELIX/32
         -28 FOR FELIX AND FELIX/28

     KEY TO SORTIE SEQUENCE:
                    TRAINING =10
                   TRANSPORT =20
                         ASW =30
                         SAR =40

               0.75 HR FLIGHT = 1
               2.25 HR FLIGHT = 2
               3.75 HR FLIGHT = 3

     **  EXAMPLE: 23 IS A 3.75 HR TRANSPORT FLIGHT  **

SORTIE SEQUENCE:
```

21	11	43	11	21	12	22	11	11	21	21	21	23	42	23	21	12	11	21	22
11	42	22	21	32	21	11	22	32	22	11	31	21	22	11	11	42	42	21	21
33	12	31	22	22	11	11	11	11	11	21	21	11	41	11	12	22	22	22	11
21	11	21	11	21	21	21	21	11	11	22	21	21	21	11	21	11	12	12	21
11	11	22	11	41	21	11	11	11	23	11	21	11	21	11	21	11	22	32	23
11	12	22	22	23	12	21	11	22	11	11	41	33	22	32	21	11	21	21	22
21	21	12	21	11	21	21	13	11	11	12	11	11	11	41	11	22	11	41	12

* MANOEUVRE SEQUENCES FOR SORTIES *

SORTIE 1-TRAINING			SORTIE 2-TRANSPORT			SORTIE 3-ASW			SORTIE 4-SAR		
NO.	MAN.	REPEATS	NO.	MAN.	REPEATS	NO.	MAN.	REPEATS	NO.	MAN.	REPEATS
1	1	2	1	1	2	1	1	1	1	1	2
2	2	3	2	2	3	2	2	3	2	2	2
3	3	0	3	3	0	3	3	0	3	3	0
4	19	1	4	19	4	4	19	1	4	19	4
5	4	3	5	4	2	5	4	3	5	4	2
6	20	1	6	20	4	6	20	1	6	20	4
7	3	0	7	5	0	7	5	0	7	5	0
8	19	2	8	7	0	8	7	0	8	7	0
9	20	2	9	6	147	9	6	8	9	6	32
10	2	4	10	10	1	10	11	2	10	10	1
11	8	1	11	6	25	11	6	2	11	6	18
12	9	6	12	11	1	12	10	4	12	-1	0
13	15	1	13	6	19	13	6	6	13	10	1

14	9	5	14	-1	0	14	10	4	14	6	92
15	13	4	15	10	4	15	6	6	15	10	2
16	12	4	16	6	82	16	11	2	16	6	53
17	15	1	17	10	4	17	6	10	17	10	1
18	9	3	18	6	96	18	10	3	18	6	26
19	2	3	19	11	1	19	6	6	19	10	1
20	3	0	20	6	109	20	11	2	20	6	19
21	19	2	21	10	4	21	6	10	21	11	1
22	4	3	22	6	27	22	11	3	22	6	43
23	20	2	23	11	1	23	6	3	23	11	1
24	5	0	24	6	48	24	10	4	24	6	50
25	7	0	25	11	1	25	6	6	25	10	2
26	6	30	26	6	17	26	11	2	26	6	63
27	10	4	27	11	1	27	6	7	27	10	1
28	11	1	28	6	42	28	11	2	28	6	101
29	6	16	29	10	4	29	6	6	29	11	1
30	10	4	30	6	10	30	11	2	30	6	43
31	6	54	31	11	1	31	6	6	31	10	1
32	11	1	32	6	52	32	21	3	32	-2	0
33	6	38	33	11	1	33	5	0	33	6	52
34	11	2	34	6	10	34	4	2	34	11	1
35	6	26	35	10	1	35	3	0	35	6	107
36	10	6	36	6	62	36	2	3	36	11	1
37	6	51	37	10	1	37	8	1	37	6	39
38	11	1	38	6	65	38	9	25	38	21	4
39	6	17	39	10	1	39	25	1	39	5	0
40	10	5	40	6	13	40	21	3	40	21	5
41	6	5	41	10	1	41	5	0	41	5	0
42	11	1	42	6	8	42	4	2	42	20	4
43	6	68	43	10	1	43	3	0	43	4	2
44	10	4	44	6	119	44	2	3	44	3	0
45	6	7	45	10	1	45	8	1	45	19	4
46	-1	0	46	6	27	46	9	17	46	2	2
47	11	1	47	10	1	47	25	1	47	8	1
48	6	31	48	6	29	48	21	2	48	9	65
49	21	6	49	10	1	49	5	0	49	12	7
50	5	0	50	6	64	50	4	3	50	14	14
51	20	1	51	-2	0	51	3	0	51	15	3
52	4	5	52	10	1	52	2	2	52	2	2
53	3	0	53	6	57	53	8	1	53	3	0
54	19	1	54	10	1	54	9	10	54	19	5
55	2	5	55	6	38	55	25	1	55	4	2
56	8	2	56	10	1	56	6	11	56	20	5
57	9	6	57	6	61	57	11	3	57	5	0
58	2	3	58	10	1	58	6	11	58	7	0
59	3	0	59	6	60	59	10	3	59	10	1
60	19	1	60	10	1	60	-1	0	60	6	49
61	4	8	61	6	48	61	21	2	61	-1	0
62	20	1	62	10	1	62	5	0	62	10	2
63	3	0	63	6	30	63	4	3	63	6	113
64	2	3	64	10	1	64	3	0	64	10	2
65	8	2	65	6	41	65	2	3	65	6	38
66	9	5	66	10	1	66	8	2	66	11	1

67	2	3	67	6	39	67	9	32	67	6	59
68	3	0	68	10	1	68	25	1	68	10	2
69	19	2	69	6	16	69	6	2	69	6	138
70	4	8	70	10	1	70	10	4	70	10	2
71	20	2	71	6	26	71	6	9	71	6	48
72	3	0	72	10	1	72	10	2	72	-2	0
73	2	3	73	6	6	73	6	10	73	10	1
74	8	1	74	10	1	74	11	2	74	6	84
75	9	46	75	6	32	75	6	7	75	10	2
76	15	2	76	11	1	76	10	3	76	6	67
77	2	3	77	6	26	77	6	7	77	10	1
78	3	0	78	10	1	78	10	3	78	6	66
79	19	1	79	6	56	79	6	6	79	21	4
80	4	3	80	10	1	80	10	3	80	5	0
81	20	1	81	6	64	81	21	2	81	21	4
82	5	0	82	10	1	82	5	0	82	5	0
83	7	0	83	6	4	83	4	3	83	20	4
84	6	5	84	10	1	84	3	0	84	4	1
85	11	1	85	6	56	85	2	2	85	3	0
86	6	9	86	11	1	86	8	2	86	19	4
87	11	1	87	6	19	87	9	51	87	2	1
88	6	31	88	10	1	88	25	1	88	8	1
89	10	5	89	6	17	89	6	6	89	9	4
90	21	6	90	11	1	90	10	3	90	13	7
91	5	0	91	6	15	91	6	3	91	15	1
92	20	1	92	16	2	92	10	4	92	22	1
93	4	4	93	17	1	93	6	5			
94	3	0	94	16	2	94	10	3			
95	19	1	95	18	1	95	6	4			
96	2	3	96	21	6	96	11	3			
97	8	1	97	5	0	97	21	2			
98	9	17	98	20	5	98	5	0			
99	2	9	99	4	3	99	4	3			
100	8	1	100	3	0	100	3	0			
101	9	55	101	19	5	101	2	3			
102	15	1	102	2	3	102	8	2			
103	14	5	103	8	1	103	9	41			
104	2	3	104	9	31	104	25	1			
105	3	0	105	2	3	105	6	9			
106	19	2	106	3	0	106	10	3			
107	4	4	107	19	4	107	6	6			
108	20	2	108	4	3	108	11	2			
109	5	0	109	20	4	109	6	4			
110	7	0	110	5	0	110	11	3			
111	6	6	111	21	3	111	6	8			
112	11	1	112	5	0	112	10	3			
113	6	7	113	20	4	113	21	3			
114	11	1	114	4	5	114	5	0			
115	6	12	115	3	0	115	4	2			
116	10	4	116	19	4	116	3	0			
117	6	37	117	2	4	117	2	3			
118	11	1	118	8	1	118	8	2			
119	6	2	119	9	10	119	9	36			
120	10	4	120	12	7	120	25	1			
121	6	77	121	15	2	121	6	7			

122	10	5
123	6	54
124	11	1
125	6	16
126	10	4
127	6	3
128	10	4
129	6	85
130	11	1
131	6	42
132	11	1
133	6	18
134	10	4
135	6	13
136	10	4
137	6	51
138	11	1
139	6	8
140	-2	0
141	11	1
142	6	67
143	10	4
144	6	4
145	10	3
146	6	2
147	10	4
148	6	3
149	11	1
150	6	6
151	10	4
152	6	2
153	11	1
154	6	8
155	11	1
156	6	2
157	10	4
158	6	79
159	16	2
160	17	1
161	16	2
162	18	1
163	5	0
164	20	2
165	4	6
166	3	0
167	19	2
168	2	3
169	8	1
170	9	13
171	2	21
172	8	1
173	9	61
174	12	3
175	14	9
176	15	2

122	14	14
123	13	7
124	15	2
125	22	2

122	10	3
123	6	6
124	10	3
125	6	6
126	10	3
127	6	10
128	10	3
129	6	10
130	10	3
131	21	2
132	5	0
133	20	1
134	4	3
135	3	0
136	19	1
137	2	3
138	8	1
139	9	44
140	25	1
141	6	6
142	10	3
143	6	5
144	10	3
145	6	7
146	10	2
147	6	5
148	11	3
149	6	5
150	10	3
151	6	7
152	11	3
153	6	2
154	10	3
155	6	9
156	10	3
157	21	2
158	5	0
159	4	3
160	3	0
161	2	3
162	8	1
163	9	42
164	25	1
165	6	2
166	10	3
167	6	2
168	11	2
169	6	13
170	10	3
171	6	6
172	11	2
173	6	6
174	10	2
175	6	1
176	11	2

177	9	34
178	13	3
179	15	1
180	14	9
181	9	24
182	2	3
183	3	0
184	19	2
185	4	3
186	20	2
187	5	0
188	7	0
189	6	6
190	11	1
191	6	2
192	10	4
193	6	4
194	10	4
195	6	48
196	10	4
197	6	75
198	11	2
199	6	25
200	10	4
201	6	62
202	10	4
203	6	2
204	11	1
205	6	2
206	11	1
207	6	9
208	10	4
209	6	30
210	11	1
211	6	51
212	10	4
213	6	53
214	21	5
215	5	0
216	4	5
217	3	0
218	2	4
219	8	1
220	9	2
221	15	1
222	22	1

177	6	8
178	10	3
179	6	4
180	10	3
181	6	3
182	10	3
183	6	6
184	10	3
185	6	2
186	10	3
187	6	2
188	10	2
189	-2	0
190	21	3
191	5	0
192	4	2
193	3	0
194	2	2
195	8	1
196	9	21
197	25	1
198	6	10
199	10	3
200	6	5
201	11	2
202	6	8
203	10	3
204	6	4
205	10	3
206	21	3
207	5	0
208	4	3
209	3	0
210	2	2
211	8	1
212	9	32
213	25	1
214	6	6
215	10	3
216	6	7
217	10	3
218	6	5
219	10	2
220	6	6
221	10	3
222	6	12
223	10	2
224	6	11
225	10	3
226	6	5
227	10	3
228	21	2
229	5	0
230	4	3
231	3	0

232	2	3
233	8	1
234	9	22
235	25	1
236	6	4
237	10	3
238	6	6
239	10	3
240	6	9
241	11	2
242	6	7
243	10	2
244	6	5
245	10	3
246	21	2
247	5	0
248	20	1
249	4	3
250	3	0
251	19	1
252	2	3
253	8	1
254	9	39
255	25	1
256	6	9
257	10	3
258	6	2
259	11	2
260	6	3
261	10	3
262	6	1
263	10	3
264	6	4
265	11	2
266	6	4
267	10	3
268	6	5
269	10	3
270	6	8
271	11	2
272	6	7
273	10	3
274	21	2
275	5	0
276	4	3
277	3	0
278	2	3
279	8	1
280	9	31
281	25	1
282	6	1
283	10	2
284	6	4
285	11	2
286	6	14

287	10	3
288	6	11
289	10	3
290	6	2
291	11	2
292	6	9
293	10	3
294	6	6
295	11	2
296	6	9
297	10	3
298	6	5
299	10	3
300	6	18
301	10	3
302	6	5
303	10	3
304	6	3
305	10	3
306	6	7
307	10	3
308	6	3
309	11	3
310	6	5
311	10	3
312	6	7
313	10	3
314	6	3
315	11	2
316	6	7
317	10	3
318	6	7
319	10	3
320	6	10
321	11	2
322	6	5
323	11	2
324	6	5
325	10	3
326	6	10
327	11	3
328	6	17
329	10	3
330	6	3
331	10	3
332	6	12
333	11	3
334	6	4
335	10	3
336	6	9
337	10	3
338	6	11
339	10	3
340	6	3
341	10	3

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342	6	10
343	10	3
344	16	2
345	17	1
346	16	2
347	18	1
348	21	10
349	5	0
350	4	7
351	3	0
352	2	7
353	8	2
354	9	30
355	12	7
356	15	2
357	14	14
358	13	7
359	15	2
360	22	1

* MANOEUVRE SEQUENCE FOR STANDARD SONAR DUNK OPERATION - FELIX/28

NUMBER	MAN-TYPE	REPEATS
1	2	3
2	3	0
3	19	1
4	4	3
5	20	1
6	5	0
7	7	0
8	6	3
9	10	2
10	6	2
11	10	2

* SUPPLEMENTARY INFORMATION *

1: MAN-TYPE -1 AND -2 INDICATE 0.75 HR AND 2.25 HR FLIGHT MARKERS

2: MAN-TYPE 25 IS STANDARD SONAR DUNK OPERATION

3: ENDS OF FLIGHTS START AT MANOEUVRE NO 214 FOR TRAINING
111 FOR TRANSPORT
348 FOR ASW
81 FOR SAR

4: STANDARD RESCUE STARTS AT MANOEUVRE NO 40 IN SAR SORTIE

* LOAD SEQUENCE FOR EACH MANOEUVRE - FELIX/28

MANNO	LOAD SEQUENCE
* 1 *	32 28 28 28 28 28 28 28 28 28 32 28 28
* 2 *	48 24
* 3 *	NO SIGNIFICANT LOADS
* 4 *	48 16
* 5 *	NO SIGNIFICANT LOADS
* 6 *	48 24
* 7 *	NO SIGNIFICANT LOADS
* 8 *	40 24
* 9 *	36 24
* 10 *	60 24
* 11 *	64 28
* 12 *	36 24

NOTE:FIRSTELEMENT IN SEQUENCE,
IS THE MEAN LOAD FOR THE MANOEUVRE

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```
*  13  *
         36  28  28  28  28  28  28  32  28  28  28  28  28  28  28

*  14  *
         36  28

*  15  *
         36  24

*  16  *
         40  32  28  32  28  28  36  28  28  44  28  28  28  32  28

*  17  *
         40  32  28  32  28  48  28  36  60  28  28  52  44  28  48  60
         60  28  28  48  32  28

*  18  *
         36  24

*  19  *
         36  28  28  36  32  28  32  32  28  28

*  20  *
         44  36  32  28  36  32  28  28  28  28  32

*  21  *
         36  28  28  28  28  28  28  28  32  28  28  28  28  28  28  28
         28  28  28  28  28  28  32  28  28  28  28  28  28

*  22  *
          8  36  36
140 SORTIES COMPLETED
TOTAL FLIGHT-TIME: 190.5 HOUR


SURVEY OF GENERATED PEAKS AND TROUGHS - FELIX/28
LEVEL:         NUMBER OF   NUMBER OF
               PEAKS:      TROUGHS:

 -28:                0         546
 -24:                0           0
 -20:                0          24
 -16:                0           0
 -12:                0           8
  -8:                0          24
```

-4:	0	40
0:	0	1472
4:	0	9442
8:	140	46402
12:	0	11835
16:	0	6402
20:	0	0
24:	0	73999
28:	0	0
32:	0	2059
36:	140	6046
40:	354	354
44:	470	333
48:	1292	2048
52:	0	0
56:	0	0
60:	12181	0
64:	47295	0
68:	6770	0
72:	81319	0
76:	3640	0
80:	2400	0
84:	3905	0
88:	24	0
92:	1080	0
96:	0	0
100:	24	0

GENERATION PROGRAM READY.

Appendix D

DETAILS OF GENERATION ALGORITHM

D.1 Outline of program

A flow chart of the general generation algorithm for Helix and Felix is illustrated in Fig 9 and flow charts for the three subroutines in Fig 9 are given in Figs 10 and 11. A description of each of the variables used in the flow charts is given in Table 37 along with a reference to the tables in this Report that list the appropriate data.

The algorithm to generate Helix and Felix increments through the sequence of sorties and for each sortie increments through the sequence of manoeuvres that define the sortie. For each manoeuvre accessed, the appropriate load sequence is applied the required number of times. Three checking routines CHECK1, CHECK2 and CHECK3 respectively decide when to skip manoeuvres in the sequence to achieve the required flight length, when to apply the standardised sonar dunk operation in the ASW sortie and when the manoeuvre to be applied is hover which has no loading sequence.

The most important aspects of the alogrithm are described in the sections that follow.

D.2 Calculation of sortie number and flight length

The sortie number and flight length are derived from the sequence of sorties, ISEQ as follows:

$$\text{ISORTE} = \text{ISEQ(I)}/10 \qquad \text{using integer arithmetic}$$

eg

$$\text{ISORTE} = 23/10 = 2$$

ie the sortie to be applied is type 2 which is transport

$$\text{the flight length} = \text{ISEQ(I)} - (10 \times \text{ISORTE})$$

eg

$$\text{flight length} = 23 - (10 \times 2) = 3$$

ie flight length 3 is required which is 3.75 hours duration.

D.3 Skipping of manoeuvres to achieve the required flight length

If a 3.75 hour flight duration is required then all the manoeuvres in MTYPE for the sortie are applied. To simulate the 0.75 hour and 2.25 hour flight durations some manoeuvres in MTYPE are skipped by the identification of the flight markers. The 0.75 hour and 2.25 hour flight markers are stored in MTYPE as manoeuvre numbers -1 and -2 respectively for each of the four sorties. The addition of the manoeuvre type number, MANNO, to the flight length number indicates whether manoeuvres must be skipped. When K is zero the flight marker for the correct flight length has been reached in MTYPE:

$$K = \text{ISEQ(I)} - (\text{ISORTE} \times 10) + \text{MANNO} \ . \qquad \text{(D-1)}$$

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For the Training, Transport and ASW sorties the next manoeuvre is that following the landing sequence marker. For the SAR sortie two jumps in the manoeuvre sequence are performed to achieve the 0.75 hour or 2.25 hour flight durations. On first encountering a 0.75 hour or 2.25 hour flight marker, with K equal to zero, the next manoeuvre is that following the SAR marker. On the second encounter of a 0.75 hour or 2.25 hour flight marker, with K equal to zero, the next manoeuvre is that following the landing sequence marker. The counter ISARJ is set to one on the first encounter of a flight marker and to zero on the second encounter in the SAR sortie thereby indicating the search and rescue portion of the SAR sortie. The manoeuvre sequence numbers for the manoeuvres that follow the landing sequence markers and SAR marker are stored in the one-dimensional matrix NEWN which has five elements. The first three elements are the manoeuvre sequence numbers of the first manoeuvre after the landing sequence marker for Training, Transport and ASW sorties. The fourth element is the manoeuvre sequence number of the manoeuvre that follows the SAR marker and the fifth element is the manoeuvre sequence number of the manoeuvre that follows the loading sequence marker in the SAR sortie. Therefore if K is zero in equation (D-1) then the next manoeuvre to be applied is at sequence number N , where

$$N = \mathrm{NEWN}(\mathrm{ISORTE} + \mathrm{ISARJ}) \quad .$$

If ISORTE equals 1, 2 or 3 then ISARJ equals zero and the first three elements of NEWN are accessed according to the value of ISORTE. If ISORTE equals 4 and K in equation (D-1) is zero for the first time, then ISARJ is zero so that the fourth element of NEWN is accessed. ISARJ is then set to one. The second time K is zero the fifth element of NEWN is accessed.

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Table 1

SEQUENCE OF SORTIES FOR 140 FLIGHT SEQUENCES OF HELIX AND FELIX

21, 11, 43, 11, 21, 12, 22, 11, 11, 21, 21, 21, 23, 42, 23, 21, 12, 11, 21, 22, 11,
42, 22, 21, 32, 21, 11, 22, 32, 22, 11, 31, 21, 22, 11, 11, 42, 42, 21, 21, 33, 12,
31, 22, 22, 11, 11, 11, 11, 11, 21, 21, 11, 41, 11, 12, 22, 22, 22, 11, 21, 11, 21,
11, 21, 21, 21, 21, 11, 11, 22, 21, 21, 21, 11, 21, 11, 12, 12, 21, 11, 11, 22, 11,
41, 21, 11, 11, 11, 23, 11, 21, 11, 21, 11, 21, 11, 22, 32, 23, 11, 12, 22, 22, 23,
12, 21, 11, 22, 11, 11, 41, 33, 22, 32, 21, 11, 21, 21, 22, 21, 21, 12, 21, 11, 21,
21, 13, 11, 11, 12, 11, 11, 11, 41, 11, 22, 11, 41, 12.

Key: Training - 10
Transport - 20
ASW - 30
SAR - 40

Shortest flight duration - 1 (0.75 hour)
Middle flight duration - 2 (2.25 hours)
Longest flight duration - 3 (3.75 hours)

therefore 23 is a transport flight of the longest duration

Table 2

NUMBER OF FLIGHTS OF EACH SORTIE FOR THE THREE FLIGHT DURATIONS IN HELIX AND FELIX

Flight duration (h)	Number of flights			
	Training	Transport	ASW	SAR
0.75	47	38	2	5
2.25	11	20	4	4
3.75	1	5	2	1

Total number of hours represented in each standard = 190.5

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Table 3

LOAD MATRIX FOR HELIX

Alternating stress			20	24	28	32	36	40
No	Manoeuvre	Mean stress	Number of cycles					
1	Take-off	44	2	-	-	-	-	-
2	Forward flight 20 kn	72	13	-	-	-	-	-
3	Forward flight 30 kn	68	-	12	2	-	-	-
4	Forward flight 40 kn	60	4	9	1	-	-	-
5	Forward flight 60 kn	60	11	2	-	-	-	-
6	Forward flight 103 kn	64	2	4	12	-	-	-
7	Maximum power climb 70 kn	68	1	-	-	-	-	-
8	Shallow approach to hover	56	12	5	6	8	4	-
9	Normal approach to hover	60	11	2	4	3	5	1
10	Hover	-	-	-	-	-	-	-
11	Bank turn port 30° Vno	68	-	1	20	1	-	-
12	Bank turn starboard 30° Vno	68	-	1	16	1	-	-
13	Sideways flight port 30 kn	56	3	-	-	-	-	-
14	Recovery from 13	52	11	5	9	1	2	-
15	Sideways flight starboard	60	3	3	3	-	-	-
16	Recovery from 15	52	11	2	3	2	4	1
17	Rearwards flight 20 kn	68	1	-	-	-	-	-
18	Recovery from 17	60	4	0	9	10	1	-
19	Spot turn port	64	30	8	2	-	-	-
20	Spot turn starboard	68	3	-	-	-	-	-
21	Autorotation	60	19	-	-	-	-	-
22	Recovery from 21	60	-	2	10	4	1	-
23	Descent	60	11	2	-	-	-	-
24	Landing	72	1	3	1	-	-	-

All stresses are expressed in Helix units

Table 4

LOAD MATRIX FOR FELIX

Alternating stress			16	24	28	32	36	44	48	52	60
No	Manoeuvre	Mean stress	Number of cycles								
1	Take-off	32	7	13	11	1	-	-	-	-	-
2	Forward flight 0.2 VNE	48	11	2	-	-	-	-	-	-	-
3	Forward flight 0.4 VNE	-	-	-	-	-	-	-	-	-	-
4	Forward flight 0.6 VNE	48	2	-	-	-	-	-	-	-	-
5	Forward flight 0.8 VNE	-	-	-	-	-	-	-	-	-	-
6	Forward flight 0.9-1.1 VNE	48	24	1	-	-	-	-	-	-	-
7	Maximum power climb 70 kn	-	-	-	-	-	-	-	-	-	-
8	Transition to hover	40	10	1	-	-	-	-	-	-	-
9	Hover	36	10	1	-	-	-	-	-	-	-
10	Cruise turns 0.4-0.8 VNE	60	20	4	-	-	-	-	-	-	-
11	Cruise turns 0.8-1.0 VNE	64	14	13	1	-	-	-	-	-	-
12	Sideways flight port	36	11	3	-	-	-	-	-	-	-
13	Sideways flight starboard	36	10	19	13	1	-	-	-	-	-
14	Rearwards	36	10	9	1	-	-	-	-	-	-
15	Spot turns	36	16	2	-	-	-	-	-	-	-
16	Autorotation (AR)	40	32	21	9	3	1	1	-	-	-
17	AR including large amplitudes	40	32	21	9	3	1	1	3	1	3
18	Recoveries from AR	36	32	2	-	-	-	-	-	-	-
19	Control reversals 0.4 VNE	36	32	12	5	3	1	-	-	-	-
20	Control reversals 0.7 VNE	44	36	13	5	3	2	-	-	-	-
21	Descent	36	-	1	26	2	-	-	-	-	-
22	Landing	8	-	-	-	-	2	-	-	-	-

All stresses are expressed as Felix units

Table 5

SEQUENCE OF LOADS FOR EACH FUNDAMENTAL MANOEUVRE IN HELIX (HELIX UNITS)

NOTE : first number represents mean load

1 Take-off

44 20 20

2 Forward flight 20 kn

72 20 20 20 20 20 20 20 20 20 20 20 20 20

3 Forward flight 30 kn

68 24 24 24 28 28 24 24 24 24 24 24 24 24 24

4 Forward flight 40 kn

60 24 24 24 20 20 20 24 24 28 20 24 24 24 24

5 Forward flight 60 kn

60 20 24 20 20 20 20 20 20 20 24 20 20 20

6 Forward flight 103 kn

64 28 28 28 28 28 24 20 28 28 28 28 24 28 24 24
28 20 28

7 Maximum power climb 70 kn

68 20

8 Shallow approach to hover

56 32 20 32 36 20 20 28 20 36 20 20 32 20 32 20
36 28 24 20 32 20 36 20 32 32 28 28 24 28 20
28 24 24 32 24

9 Normal approach to hover

60 20 28 20 20 28 36 20 28 36 28 20 24 20 36 36
40 24 20 32 32 32 20 20 36 20 20

10 Hover

No significant loads

11 Bank turn port 30° Vno

68 28 28 28 28 28 28 28 28 28 32 28 28 28 28 28
28 28 28 28 28 28 24

12 Bank turn starboard 30° Vno

68 24 32 28 28 28 28 28 28 28 28 28 28 28 28 28
28 28 28

13 Sideways flight port 30 kn

56 20 20 20

Table 5 (concluded)

14 Recovery from sideways flight to port

52 20 28 28 36 24 20 24 28 20 32 20 20 36 20 20
24 28 28 20 28 28 20 24 20 24 28 28 20

15 Sideways flight to starboard

60 24 20 20 24 24 28 28 28 20

16 Recovery from sideways flight to starboard

52 36 20 36 32 20 28 40 36 36 20 20 24 20 24 20
20 28 20 28 20 20 32 20

17 Rearwards flight 20 kn

68 20

18 Recovery from rearwards flight

60 32 28 32 28 28 28 32 28 28 36 20 20 32 32 20
28 32 28 32 32 32 20 32 28

19 Spot turn port

64 20 20 20 20 20 28 20 24 20 20 28 20 24 24 20
20 20 20 20 20 20 20 24 20 20 24 20 20 24 20
20 24 20 20 20 20 20 20 24 20

20 Spot turn starboard

68 20 20 20

21 Autorotation

60 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
20 20 20 20

22 Recovery from autorotation

60 28 28 24 28 24 32 36 28 28 28 32 28 28 32 32
28 28

23 Descent

60 24 20 20 20 20 20 20 20 20 20 20 20 24

24 Landing

72 28 24 24 24 20

Table 6

SEQUENCE OF LOADS FOR EACH FUNDAMENTAL MANOEUVRE IN FELIX (FELIX UNITS)

NOTE : first number represents mean load

1 Take-off

32	16	24	28	28	24	16	16	24	24	28	16	28	24	24	24
	24	24	16	24	16	28	28	24	28	28	24	28	24	32	28
	28	16													

2 Forward flight at 0.2 Vne

48	16	16	24	16	16	16	16	16	24	16	16	16	16

3 Forward flight at 0.4 Vne

No significant loads

4 Forward flight at 0.6 Vne

48	16	16

5 Forward flight at 0.8 Vne

No significant loads

6 Forward flight at 0.9 - 1.1 Vne

48	16	16	16	16	16	16	16	16	16	16	24	16	16	16	16
	16	16	16	16	16	16	16	16	16	16					

7 Maximum power climb 70 kn

No significant loads

8 Transition to hover

40	16	16	16	24	16	16	16	16	16	16	16

9 Hover

36	16	16	16	16	16	16	16	24	16	16	16

10 Cruise turns 0.4 - 0.8 Vne

60	16	16	24	16	16	16	16	16	16	24	16	24	16	16	16
	16	16	16	16	24	16	16	16	16						

11 Cruise turns 0.8 - 1.0 Vne

64	24	16	16	16	24	24	24	24	24	16	24	16	24	16	24
	24	16	16	16	16	16	24	16	28	24	16	16	24		

12 Sideways flight port

36	16	16	24	16	16	16	16	24	16	24	16	16	16	16

13 Sideways flight starboard

36	16	24	16	28	24	24	24	16	16	24	24	28	24	28	24
	28	28	28	24	24	24	24	16	24	24	32	28	28	24	24
	28	16	28	28	24	16	24	28	28	16	16	24	16		

Table 6 (concluded)

14 Rearwards flight

36	24	16	16	24	16	16	16	24	24	16	28	16	24	24	24
	24	16	24	16	16										

15 Spot turns

36	16	16	16	16	16	24	16	16	16	24	16	16	16	16	16
	16	16	16												

16 Autorotation

40	16	16	16	32	16	28	24	16	16	16	24	16	24	16	32
	28	16	16	16	24	28	16	24	36	16	24	16	16	28	24
	24	28	44	24	28	24	16	24	16	16	24	24	24	16	24
	16	28	16	16	24	28	24	16	16	24	16	16	24	24	32
	28	16	16	16	16	24	16								

17 Autorotation including large amplitudes in 3.75 hour flights only

40	16	16	16	32	16	28	24	16	16	16	24	16	24	16	32
	28	16	16	48	16	24	28	16	24	36	60	16	24	16	16
	28	24	24	28	52	44	24	28	48	24	60	16	24	16	16
	24	24	24	16	24	16	60	28	16	16	24	28	24	16	16
	24	16	16	48	24	24	32	28	16	16	16	16	24	16	

18 Recoveries from autorotation

36	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	16	16	16	16	16	24	16	16	16	16	16	24	16	16	16
	16	16	16	16											

19 Control reversals 0.4 Vne

36	16	16	24	28	16	16	16	24	16	24	16	16	24	16	24
	16	28	16	36	32	28	16	16	16	16	16	16	16	24	24
	16	16	32	24	32	24	16	16	24	16	28	16	16	28	16
	16	24	16	16	16	24	16	16							

20 Control reversals 0.7 Vne

44	16	16	16	36	16	24	16	16	16	16	16	32	24	16	16
	16	24	28	16	16	24	36	24	32	16	16	16	16	28	16
	24	24	28	24	16	16	24	16	24	16	28	16	16	16	16
	16	16	24	16	16	28	16	32	24	24	16	16	16	16	

21 Descent

36	28	28	28	24	28	28	28	28	32	28	28	28	28	28	28
	28	28	28	28	28	28	28	32	28	28	28	28	28	28	

22 Landing

8	36	36

Table 7

SEQUENCE OF MANOEUVRES IN A TRAINING SORTIE

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
1	Take-off	1	36	6
2	Forward flight 20 kn	2	12	3
3	Forward flight 30 kn	3	12	2
4	Forward flight 40 kn	4	12	3
5	Forward flight 30 kn	3	18	3
6	Forward flight 20 kn	2	20	5
7	Normal approach to hover	9	12	3
8	Hover	10	62	0
9	Spot turn port	19	18	1
10	Hover	10	45	0
11	Sideways to starboard	15	14	4
12	Recovery from sideways to starboard	16	10	2
13	Sideways to port	13	16	4
14	Recovery from sideways to port	14	10	2
15	Spot turn starboard	20	18	1
16	Hover	10	25	0
17	Forward flight 20 kn	2	12	3
18	Forward flight 30 kn	3	12	2
19	Forward flight 40 kn	4	12	3
20	Forward flight 60 kn	5	32	8
21	Maximum power climb 70 kn	7	21	7
22	Forward flight 103 kn	6	210	42
23	Bank turn port	11	12	2
24	Bank turn starboard	12	10	2
25	Forward flight 103 kn	6	115	23
26	Bank turn port	11	12	2
27	Forward flight 103 kn	6	350	70
28	Bank turn starboard	12	10	2
29	Forward flight 103 kn	6	260	52
30	Bank turn starboard	12	10	2
31	Forward flight 103 kn	6	175	35
32	Bank turn port	11	12	2
33	Forward flight 103 kn	6	315	63
34	Bank turn starboard	12	10	2
35	Forward flight 103 kn	6	105	21
36	Bank turn port	11	12	2
37	Forward flight 103 kn	6	25	5
38	Bank turn starboard	12	10	2
39	Forward flight 103 kn	6	415	83
40	Bank turn port	11	12	2
41	Forward flight 103 kn	6	40	8
42	0.75 hour flight marker	-1	-	-
43	Bank turn starboard	12	10	2
44	Forward flight 103 kn	6	195	39
45	Descent	23	25	5
46	Forward flight 60 kn	5	32	8
47	Forward flight 40 kn	4	24	6
48	Forward flight 30 kn	3	24	4
49	Forward flight 20 kn	2	24	6
50	Normal approach to hover	9	12	3
51	Hover	10	55	0
52	Forward flight 20 kn	2	12	3
53	Forward flight 30 kn	3	12	2
54	Forward flight 40 kn	4	36	9
55	Forward flight 30 kn	3	24	4
56	Forward flight 20 kn	2	12	3

Table 7 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
57	Normal approach to hover	9	12	3
58	Hover	10	45	0
59	Forward flight 20 kn	2	12	3
60	Forward flight 30 kn	3	12	2
61	Forward flight 40 kn	4	40	10
62	Forward flight 30 kn	3	24	4
63	Forward flight 20 kn	2	12	3
64	Normal approach to hover	9	12	3
65	Hover	10	450	0
66	Spot turn port	19	18	1
67	Forward flight 20 kn	2	12	3
68	Forward flight 30 kn	3	12	2
69	Forward flight 40 kn	4	12	3
70	Forward flight 60 kn	5	40	10
71	Maximum power climb 70 kn	7	18	6
72	Forward flight 103 kn	6	35	7
73	Bank turn starboard	12	10	2
74	Forward flight 103 kn	6	65	13
75	Bank turn starboard	12	10	2
76	Forward flight 103 kn	6	215	43
77	Bank turn port	11	12	2
78	Descent	23	25	5
79	Forward flight 60 kn	5	40	10
80	Forward flight 40 kn	4	16	4
81	Forward flight 30 kn	3	18	3
82	Forward flight 20 kn	2	12	3
83	Normal approach to hover	9	12	3
84	Hover	10	159	0
85	Forward flight 20 kn	2	36	9
86	Normal approach to hover	9	12	3
87	Hover	10	530	0
88	Spot turn starboard	20	18	1
89	Rearwards flight	17	10	4
90	Recovery from rearwards flight	18	6	1
91	Forward flight 20 kn	2	12	3
92	Forward flight 30 kn	3	12	2
93	Forward flight 40 kn	4	12	3
94	Forward flight 60 kn	5	48	12
95	Maximum power climb 70 kn	7	18	6
96	Forward flight 103 kn	6	35	7
97	Bank turn starboard	12	10	2
98	Forward flight 103 kn	6	45	9
99	Bank turn starboard	12	10	2
100	Forward flight 103 kn	6	75	15
101	Bank turn port	11	12	2
102	Forward flight 103 kn	6	225	45
103	Bank turn starboard	12	10	2
104	Forward flight 103 kn	6	15	3
105	Bank turn port	11	12	2
106	Forward flight 103 kn	6	475	95
107	Bank turn port	11	12	2
108	Forward flight 103 kn	6	335	67
109	Bank turn starboard	12	10	2
110	Forward flight 103 kn	6	95	19
111	Bank turn port	11	12	2
112	Forward flight 103 kn	6	15	3
113	Bank turn port	11	12	2
114	Forward flight 103 kn	6	530	106

Table 7 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
115	Bank turn starboard		12	10	2
116	Forward flight	103 kn	6	265	53
117	Bank turn starboard		12	10	2
118	Forward flight	103 kn	6	115	23
119	Bank turn port		11	12	2
120	Forward flight	103 kn	6	85	17
121	Bank turn port		11	12	2
122	Forward flight	103 kn	6	315	63
123	Bank turn starboard		12	10	2
124	Forward flight	103 kn	6	50	10
125	2.25 hour flight marker		-2	-	0
126	Bank turn starboard		12	10	2
127	Forward flight	103 kn	6	415	83
128	Bank turn port		11	12	2
129	Forward flight	103 kn	6	25	5
130	Bank turn port		11	12	2
131	Forward flight	103 kn	6	15	3
132	Bank turn port		11	12	2
133	Forward flight	103 kn	6	20	4
134	Bank turn starboard		12	10	2
135	Forward flight	103 kn	6	35	7
136	Bank turn port		11	12	2
137	Forward flight	103 kn	6	15	3
138	Bank turn starboard		12	10	2
139	Forward flight	103 kn	6	45	9
140	Bank turn starboard		12	10	2
141	Forward flight	103 kn	6	15	3
142	Bank turn port		11	12	2
143	Forward flight	103 kn	6	490	98
144	Autorotation		21	60	12
145	Recovery from autorotation		22	5	1
146	Forward flight	60 kn	5	164	41
147	Forward flight	40 kn	4	24	6
148	Forward flight	30 kn	3	24	4
149	Forward flight	20 kn	2	12	3
150	Shallow approach to hover		8	10	2
151	Hover		10	116	0
152	Forward flight	20 kn	2	88	22
153	Normal approach to hover		9	12	3
154	Hover		10	560	0
155	Sideways to port		13	8	2
156	Recovery from sideways to port		14	10	2
157	Rearwards flight		17	15	6
158	Recovery from rearwards flight		18	12	2
159	Spot turn port		19	18	1
160	Spot turn starboard		20	18	1
161	Hover		10	320	0
162	Sideways to starboard		15	14	4
163	Recovery from sideways to starboard		16	5	1
164	Spot turn port		19	18	1
165	Rearwards flight		17	15	6
166	Recovery from rearwards flight		18	12	2
167	Hover		10	215	0
168	Forward flight	20 kn	2	12	3
169	Forward flight	30 kn	3	12	2
170	Forward flight	40 kn	4	12	3
171	Forward flight	60 kn	5	48	12
172	Maximum power climb	70 kn	7	12	4

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Table 7 (concluded)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
173	Forward flight 103 kn	6	20	4
174	Bank turn starboard	12	10	2
175	Forward flight 103 kn	6	15	3
176	Bank turn port	11	12	2
177	Forward flight 103 kn	6	25	5
178	Bank turn port	11	12	2
179	Forward flight 103 kn	6	295	59
180	Bank turn port	11	12	2
181	Forward flight 103 kn	6	465	93
182	Bank turn starboard	12	10	2
183	Forward flight 103 kn	6	155	31
184	Bank turn port	11	12	2
185	Forward flight 103 kn	6	380	76
186	Bank turn port	11	12	2
187	Forward flight 103 kn	6	15	3
188	Bank turn starboard	12	10	2
189	Forward flight 103 kn	6	10	2
190	Bank turn starboard	12	10	2
191	Forward flight 103 kn	6	55	11
192	Bank turn port	11	12	2
193	Forward flight 103 kn	6	180	36
194	Bank turn starboard	12	10	2
195	Forward flight 103 kn	6	305	61
196	Bank turn port	11	12	2
197	Forward flight 103 kn	6	320	64
	Landing sequence marker	-	-	-
198	Descent	23	20	4
199	Forward flight 60 kn	5	24	6
200	Forward flight 40 kn	4	16	4
201	Forward flight 30 kn	3	12	2
202	Forward flight 20 kn	2	16	4
203	Normal approach to hover	9	12	3
204	Hover	10	15	0
205	Spot turn port	19	18	1
206	Landing	24	18	3

Table 8

SEQUENCE OF MANOEUVRES IN TRANSPORT SORTIE

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
1	Take-off		1	36	6
2	Forward flight	20 kn	2	12	3
3	Forward flight	30 kn	3	12	2
4	Forward flight	40 kn	4	12	3
5	Forward flight	60 kn	5	156	39
6	Maximum power climb	70 kn	7	60	20
7	Forward flight	103 kn	6	980	196
8	Bank turn starboard		12	5	1
9	Forward flight	103 kn	6	170	34
10	Bank turn starboard		12	5	1
11	Forward flight	103 kn	6	130	26
12	0.75 hour flight marker		-1	-	-
13	Bank turn port		11	6	1
14	Forward flight	103 kn	6	495	99
15	Bank turn port		11	6	1
16	Forward flight	103 kn	6	580	116
17	Bank turn starboard		12	5	1
18	Forward flight	103 kn	6	660	132
19	Bank turn port		11	6	1
20	Forward flight	103 kn	6	165	33
21	Bank turn starboard		12	5	1
22	Forward flight	103 kn	6	295	59
23	Bank turn starboard		12	5	1
24	Forward flight	103 kn	6	110	22
25	Bank turn starboard		12	5	1
26	Forward flight	103 kn	6	260	52
27	Bank turn port		11	6	1
28	Forward flight	103 kn	6	60	12
29	Bank turn starboard		12	5	1
30	Forward flight	103 kn	6	320	64
31	Bank turn starboard		12	5	1
32	Forward flight	103 kn	6	60	12
33	Bank turn port		11	6	1
34	Forward flight	103 kn	6	370	74
35	Bank turn port		11	6	1
36	Forward flight	103 kn	6	390	78
37	Bank turn port		11	6	1
38	Forward flight	103 kn	6	75	15
39	Bank turn port		11	6	1
40	Forward flight	103 kn	6	50	10
41	Bank turn port		11	6	1
42	Forward flight	103 kn	6	705	141
43	Bank turn starboard		12	5	1
44	Forward flight	103 kn	6	155	31
45	Bank turn port		11	6	1
46	Forward flight	103 kn	6	175	35
47	Bank turn starboard		12	5	1
48	Forward flight	103 kn	6	375	75
49	2.25 hour flight marker		-2	-	-
50	Bank turn starboard		12	5	1
51	Forward flight	103 kn	6	360	72
52	Bank turn port		11	6	1
53	Forward flight	103 kn	6	245	49
54	Bank turn starboard		12	5	1
55	Forward flight	103 kn	6	390	78
56	Bank turn starboard		12	5	1

Table 8 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
57	Forward flight	103 kn	6	380	76
58	Bank turn starboard		12	5	1
59	Forward flight	103 kn	6	305	61
60	Bank turn starboard		12	5	1
61	Forward flight	103 kn	6	195	39
62	Bank turn starboard		12	5	1
63	Forward flight	103 kn	6	260	52
64	Bank turn port		11	6	1
65	Forward flight	103 kn	6	250	50
66	Bank turn port		11	6	1
67	Forward flight	103 kn	6	105	21
68	Bank turn starboard		12	5	1
69	Forward flight	103 kn	6	175	35
70	Bank turn starboard		12	5	1
71	Forward flight	103 kn	6	25	5
72	Bank turn port		11	6	1
73	Forward flight	103 kn	6	215	43
74	Bank turn starboard		12	5	1
75	Forward flight	103 kn	6	160	32
76	Bank turn port		11	6	1
77	Forward flight	103 kn	6	370	74
78	Bank turn starboard		12	5	1
79	Forward flight	103 kn	6	425	85
80	Bank turn port		11	6	1
81	Forward flight	103 kn	6	25	5
82	Bank turn port		11	6	1
83	Forward flight	103 kn	6	360	72
84	Bank turn starboard		12	5	1
85	Forward flight	103 kn	6	125	25
86	Bank turn port		11	6	1
87	Forward flight	103 kn	6	110	22
88	Bank turn starboard		12	5	1
89	Forward flight	103 kn	6	100	20
90	Autorotation		21	60	12
91	Recovery from autorotation		22	5	1
92	Descent		23	20	4
93	Forward flight	60 kn	5	152	38
94	Forward flight	40 kn	4	12	3
95	Forward flight	30 kn	3	12	2
96	Forward flight	20 kn	2	12	3
97	Shallow approach to hover		8	15	3
98	Hover		10	272	0
99	Forward flight	20 kn	2	12	3
100	Forward flight	30 kn	3	12	2
101	Forward flight	40 kn	4	12	3
102	Forward flight	60 kn	5	116	29
	Landing sequence marker		-	-	-
103	Descent		23	15	3
104	Forward flight	60 kn	5	732	183
105	Forward flight	40 kn	4	20	5
106	Forward flight	30 kn	3	18	3
107	Forward flight	20 kn	2	16	4
108	Shallow approach to hover		8	10	2
109	Hover		10	113.5	-
110	Sideways to port		13	32	8
111	Recovery from sideways to port		14	10	2
112	Spot turn to port		19	18	1

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Table 8 (concluded)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (h)	Matrix applications
113	Rearwards flight	17	30	12
114	Recovery from rearwards flight	18	12	2
115	Sideways to starboard	15	31.5	9
116	Recovery from sideways to starboard	16	10	2
117	Spot turn to starboard	20	18	1
118	Landing	24	36	6

Table 9

SEQUENCE OF MANOEUVRES IN ASW SORTIE

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
	Initial transit			
1	Take-off	1	18	2
2	Forward flight 20 kn	2	12	3
3	Forward flight 30 kn	3	12	2
4	Forward flight 40 kn	4	12	3
5	Forward flight 60 kn	5	24	6
6	Maximum power climb 70 kn	7	12	4
7	Forward flight 103 kn	6	50	10
8	Bank turn starboard	12	10	2
9	Forward flight 103 kn	6	10	2
10	Bank turn port	11	12	2
11	Forward flight 103 kn	6	35	7
12	Bank turn port	11	12	2
13	Forward flight 103 kn	6	40	8
14	Bank turn starboard	12	10	2
15	Forward flight 103 kn	6	60	12
16	Bank turn port	11	12	2
17	Forward flight 103 kn	6	40	8
18	Bank turn starboard	12	10	2
19	Forward flight 103 kn	6	65	13
20	Bank turn starboard	12	10	2
21	Forward flight 103 kn	6	20	4
22	Bank turn port	11	12	2
23	Forward flight 103 kn	6	40	8
24	Bank turn starboard	12	10	2
25	Forward flight 103 kn	6	45	9
26	Bank turn starboard	12	10	2
27	Forward flight 103 kn	6	40	8
28	Bank turn starboard	12	10	2
29	Forward flight 103 kn	6	35	7
	First sonar dunk			
30	First combined manoeuvre (hover time 243 seconds)	25	452	1
	Second sonar dunk			
31	Second combined manoeuvre (hover time 162 seconds)	25	371	1
	Third sonar dunk			
32	Third combined manoeuvre (hover time 101 seconds)	25	310	1
33	Forward flight 103 kn	6	65	13
34	Bank turn starboard	12	10	2
35	Forward flight 103 kn	6	70	14
36	Bank turn starboard	12	10	2
37	0.75 hour flight marker	-1	-	-
	Fourth sonar dunk			
38	Fourth combined manoeuvre (hover time 296 seconds)	25	505	1
39	Forward flight 103 kn	6	10	2
40	Bank turn port	11	12	2
41	Forward flight 103 kn	6	60	12
42	Bank turn starboard	12	10	2
43	Forward flight 103 kn	6	65	13
44	Bank turn starboard	12	10	2
45	Forward flight 103 kn	6	45	9
46	Bank turn starboard	12	10	2

Table 9 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
47	Forward flight 103 kn	6	45	9
48	Bank turn port	11	12	2
49	Forward flight 103 kn	6	40	8
50	Bank turn port	11	12	2
	Fifth sonar dunk			
51	Fifth combined manoeuvre (hover time 474 seconds)	25	683	1
52	Forward flight 103 kn	6	45	9
53	Bank turn port	11	12	2
54	Forward flight 103 kn	6	20	4
55	Bank turn port	11	12	2
56	Forward flight 103 kn	6	30	6
57	Bank turn port	11	12	2
58	Forward flight 103 kn	6	25	5
59	Bank turn starboard	12	10	2
	Sixth sonar dunk			
60	Sixth combined manoeuvre (hover time 373 seconds)	25	582	1
61	Forward flight 103 kn	6	55	11
62	Bank turn port	11	12	2
63	Forward flight 103 kn	6	40	8
64	Bank turn starboard	12	10	2
65	Forward flight 103 kn	6	25	5
66	Bank turn starboard	12	10	2
67	Forward flight 103 kn	6	55	11
68	Bank turn starboard	12	10	2
	Seventh sonar dunk			
69	Seventh combined manoeuvre (hover time 330 seconds)	25	539	1
70	Forward flight 103 kn	6	45	9
71	Bank turn port	11	12	2
72	Forward flight 103 kn	6	35	7
73	Bank turn port	11	12	2
74	Forward flight 103 kn	6	35	7
75	Bank turn port	11	12	2
76	Forward flight 103 kn	6	70	14
77	Bank turn port	11	12	2
78	Forward flight 103 kn	6	65	13
79	Bank turn starboard	12	10	2
	Eighth sonar dunk			
80	Eighth combined manoeuvre (hover time 419 seconds)	25	628	1
81	Forward flight 103 kn	6	35	7
82	Bank turn port	11	12	2
83	Forward flight 103 kn	6	35	7
84	Bank turn port	11	12	2
85	Forward flight 103 kn	6	45	9
86	Bank turn starboard	12	10	2
87	Forward flight 103 kn	6	30	6
88	Bank turn starboard	12	10	2
89	Forward flight 103 kn	6	30	6
90	Bank turn port	11	12	2
91	Forward flight 103 kn	6	50	10
92	Bank turn starboard	12	10	2
93	Forward flight 103 kn	6	15	3
94	Bank turn port	11	12	2
95	Forward flight 103 kn	6	60	12
96	Bank turn port	11	12	2

Table 9 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
	Ninth sonar dunk			
97	Ninth combined manoeuvre (hover time 390 seconds)	25	599	1
98	Forward flight 103 kn	6	10	2
99	Bank turn port	11	12	2
100	Forward flight 103 kn	6	10	2
101	Bank turn starboard	12	10	2
102	Forward flight 103 kn	6	75	15
103	Bank turn port	11	12	2
104	Forward flight 103 kn	6	35	7
105	Bank turn starboard	12	10	2
106	Forward flight 103 kn	6	30	6
107	Bank turn starboard	12	10	2
108	Forward flight 103 kn	6	5	1
109	Bank turn starboard	12	10	2
110	Forward flight 103 kn	6	45	9
111	Bank turn starboard	12	10	2
112	Forward flight 103 kn	6	25	5
113	Bank turn port	11	12	2
114	Forward flight 103 kn	6	20	4
115	Bank turn port	11	12	2
116	Forward flight 103 kn	6	40	8
117	Bank turn starboard	12	10	2
118	Forward flight 103 kn	6	10	2
119	Bank turn port	11	12	2
120	Forward flight 103 kn	6	10	2
121	Bank turn starboard	12	10	2
122	2.25 hour flight marker	-	-	-
	Tenth sonar dunk			
123	Tenth combined manoeuvre (hover time 190 seconds)	25	399	1
124	Forward flight 103 kn	6	70	14
125	Bank turn port	11	12	2
126	Forward flight 103 kn	6	30	6
127	Bank turn starboard	12	10	2
128	Forward flight 103 kn	6	50	10
129	Bank turn starboard	12	10	2
130	Forward flight 103 kn	6	25	5
131	Bank turn port	11	12	2
	Eleventh sonar dunk			
132	Eleventh combined manoeuvre (hover time 290 seconds)	25	499	1
133	Forward flight 103 kn	6	40	8
134	Bank turn port	12	10	2
135	Forward flight 103 kn	6	45	9
136	Bank turn port	11	12	2
137	Forward flight 103 kn	6	30	6
138	Bank turn starboard	12	10	2
139	Forward flight 103 kn	6	35	7
140	Bank turn port	11	12	2
141	Forward flight 103 kn	6	80	16
142	Bank turn starboard	12	10	2
143	Forward flight 103 kn	6	75	15
144	Bank turn port	11	12	2
145	Forward flight 103 kn	6	30	6
146	Bank turn port	11	12	2

Table 9 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
	Twelfth sonar dunk				
147	Twelfth combined manoeuvre (hover time 207 seconds)		25	416	1
148	Forward flight	103 kn	6	25	5
149	Bank turn port		11	12	2
150	Forward flight	103 kn	6	35	7
151	Bank turn port		11	12	2
152	Forward flight	103 kn	6	65	13
153	Bank turn starboard		12	10	2
154	Forward flight	103 kn	6	45	9
155	Bank turn starboard		12	10	2
156	Forward flight	103 kn	6	30	6
157	Bank turn port		11	12	2
	Thirteenth sonar dunk				
158	Thirteenth combined manoeuvre (hover time 374 seconds)		25	583	1
159	Forward flight	103 kn	6	55	11
160	Bank turn starboard		12	10	2
161	Forward flight	103 kn	6	15	3
162	Bank turn starboard		12	10	2
163	Forward flight	103 kn	6	20	4
164	Bank turn port		11	12	2
165	Forward flight	103 kn	6	5	1
166	Bank turn port		11	12	2
167	Forward flight	103 kn	6	25	5
168	Bank turn starboard		12	10	2
169	Forward flight	103 kn	6	25	5
170	Bank turn port		11	12	2
171	Forward flight	102 kn	6	35	7
172	Bank turn port		11	12	2
173	Forward flight	103 kn	6	50	10
174	Bank turn starboard		12	10	2
175	Forward flight	103 kn	6	40	8
176	Bank turn port		11	12	2
	Fourteenth sonar dunk				
177	Fourteenth combined manoeuvre (hover time 290 seconds)		25	499	1
178	Forward flight	103 kn	6	5	1
179	Bank turn port		11	6	1
180	Forward flight	103 kn	6	25	5
181	Bank turn starboard		12	10	2
182	Forward flight	103 kn	6	80	16
183	Bank turn port		11	12	2
184	Forward flight	103 kn	6	60	12
185	Bank turn port		11	12	2
186	Forward flight	103 kn	6	15	3
187	Bank turn starboard		12	10	2
188	Forward flight	103 kn	6	50	10
189	Bank turn port		11	12	2
190	Forward flight	103 kn	6	40	8
191	Bank turn starboard		12	10	2
192	Forward flight	103 kn	6	50	10
193	Bank turn port		11	12	2
194	Forward flight	103 kn	6	30	6
195	Bank turn port		11	12	2
196	Forward flight	103 kn	6	110	22

Table 9 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
197	Bank turn port	11	12	2
198	Forward flight 103 kn	6	30	6
199	Bank turn port	11	12	2
200	Forward flight 103 kn	6	20	4
201	Bank turn port	11	12	2
202	Forward flight 103 kn	6	40	8
203	Bank turn port	11	12	2
204	Forward flight 103 kn	6	20	4
205	Bank turn starboard	12	10	2
206	Forward flight 103 kn	6	30	6
207	Bank turn port	11	12	2
208	Forward flight 103 kn	6	35	7
209	Bank turn port	11	12	2
210	Forward flight 103 kn	6	15	3
211	Bank turn starboard	12	10	2
212	Forward flight 103 kn	6	35	7
213	Bank turn port	11	12	2
214	Forward flight 103 kn	6	40	8
215	Bank turn port	11	12	2
216	Forward flight 103 kn	6	60	12
217	Bank turn starboard	12	10	2
218	Forward flight 103 kn	6	30	6
219	Bank turn starboard	12	10	2
220	Forward flight 103 kn	6	30	6
221	Bank turn port	11	12	2
222	Forward flight 103 kn	6	55	11
223	Bank turn starboard	12	10	2
224	Forward flight 103 kn	6	100	20
225	Bank turn port	11	12	2
226	Forward flight 103 kn	6	20	4
227	Bank turn port	11	12	2
228	Forward flight 103 kn	6	75	15
229	Bank turn starboard	12	10	2
230	Forward flight 103 kn	6	25	5
231	Bank turn port	11	12	2
232	Forward flight 103 kn	6	55	11
233	Bank turn port	11	12	2
234	Forward flight 103 kn	6	65	13
235	Bank turn port	11	12	2
236	Forward flight 103 kn	6	20	4
237	Bank turn port	11	12	2
238	Forward flight 103 kn	6	60	12
239	Bank turn port	11	12	2
240	Autorotation	21	60	12
241	Recovery from autorotation	22	5	1
	Landing sequence marker	-	-	-
242	Descent	23	40	8
243	Forward flight 60 kn	5	108	27
244	Forward flight 40 kn	4	28	7
245	Forward flight 30 kn	3	30	5
246	Forward flight 20 kn	2	28	7
247	Normal approach to hover	9	20	5
248	Hover	10	293.5	0
249	Sideways to port	13	32	8
250	Recovery from sidewavs to port	14	10	2
251	Spot turn port	19	18	1

Table 9 (concluded

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
252	Rearwards flight	17	30	12
253	Recovery from rearwards flight	18	12	2
254	Sideways to starboard	15	31.5	9
255	Recovery from sideways to starboard	16	10	2
256	Spot turn starboard	20	18	1
257	Landing	24	18	3

Table 10

SEQUENCE OF MANOEUVRES IN SAR SORTIE

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
1	Take-off	1	36	6
2	Forward flight 20 kn	2	8	2
3	Forward flight 30 kn	3	6	1
4	Forward flight 40 kn	4	8	2
5	Forward flight 60 kn	5	32	8
6	Maximum power climb 70 kn	7	30	10
7	Forward flight 103 kn	6	315	63
8	Bank turn port	11	6	1
9	Forward flight 103 kn	6	195	39
10	First 0.75 hour flight marker	-1	-	-
11	Bank turn starboard	12	5	1
12	Forward flight 103 kn	6	550	110
13	Bank turn port	11	6	1
14	Forward flight 103 kn	6	320	64
15	Bank turn starboard	12	5	1
16	Forward flight 103 kn	6	155	31
17	Bank turn starboard	12	5	1
18	Forward flight 103 kn	6	115	23
19	Bank turn starboard	12	5	1
20	Forward flight 103 kn	6	255	51
21	Bank turn starboard	12	5	1
22	Forward flight 103 kn	6	300	60
23	Bank turn port	11	6	1
24	Forward flight 103 kn	6	375	75
25	Bank turn starboard	12	5	1
26	Forward flight 103 kn	6	605	121
27	Bank turn starboard	12	5	1
28	Forward flight 103 kn	6	260	52
29	Bank turn port	11	6	1
30	First 2.25 hour flight marker	-2	-	-
31	Forward flight 103 kn	6	310	62
32	Bank turn starboard	12	5	1
33	Forward flight 103 kn	6	640	128
34	Bank turn starboard	12	5	1
35	Forward flight 103 kn	6	250	50
36	Descent	23	20	4
37	Forward flight 60 kn	5	2000	500
	SAR marker	-	-	-
38	Descent	23	20	4
39	Forward flight 60 kn	5	580	145
40	Forward flight 40 kn	4	8	2
41	Forward flight 30 kn	3	6	1
42	Forward flight 20 kn	2	8	2
43	Normal approach to hover	9	8	2
44	Hover	10	600	0
45	Sideways to port	13	32	8
46	Recovery from sideways to port	14	10	2
47	Rearwards flight	17	30	12
48	Recovery from rearwards	18	12	2
49	Spot turn starboard	20	18	1
50	Forward flight 20 kn	2	8	2
51	Forward flight 30 kn	3	6	1
52	Forward flight 40 kn	4	8	2
53	Forward flight 60 kn	5	64	16
54	Maximum power climb 70 kn	7	30	10

Table 10 (concluded)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
54	Bank turn port		11	6	1
56	Forward flight	103 kn	6	390	78
57	Second 0.75 hour flight marker		-1	-	-
58	Bank turn port		11	6	1
59	Forward flight	103 kn	6	680	136
60	Bank turn port		11	6	1
61	Forward flight	103 kn	6	230	46
62	Bank turn starboard		12	5	1
63	Forward flight	103 kn	6	355	71
64	Bank turn starboard		12	5	1
65	Forward flight	103 kn	6	830	166
66	Bank turn starboard		12	5	1
67	Forward flight	103 kn	6	290	58
68	Second 2.25 hour flight marker		-2	-	-
69	Bank turn port		11	6	1
70	Forward flight	103 kn	6	525	105
71	Bank turn port		11	6	1
72	Forward flight	103 kn	6	415	83
73	Bank turn port		11	6	1
74	Forward flight	103 kn	6	405	81
75	Descent		23	15	3
76	Forward flight	60 kn	5	792	198
	Landing sequence marker		-	-	-
77	Descent		23	20	4
78	Forward flight	60 kn	5	32	8
79	Forward flight	40 kn	4	8	2
80	Forward flight	30 kn	3	12	2
81	Forward flight	20 kn	2	8	2
82	Normal approach to hover		9	4	1
83	Hover		10	58.5	0
84	Sideways to starboard		15	31.5	9
85	Recovery from sideways to starboard		16	10	2
86	Spot turn port		19	18	1
87	Landing		24	18	3

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Table 11

SEQUENCE OF MANOEUVRES IN COMBINED MANOEUVRE IN ASW SORTIE (HELIX)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
1	Descent		23	10	2
2	Forward flight	60 kn	5	24	6
3	Forward flight	40 kn	4	12	3
4	Forward flight	30 kn	3	12	2
5	Forward flight	20 kn	2	12	3
6	Normal approach to hover		9	12	3
7	Hover		10	variable	none
8	Forward flight	20 kn	2	12	3
9	Forward flight	30 kn	3	12	2
10	Forward flight	40 kn	4	12	3
11	Forward flight	60 kn	5	24	6
12	Maximum power climb		7	12	4
13	Forward flight	103 kn	6	20	4
14	Bank turn starboard		12	10	2
15	Forward flight	103 kn	6	15	3
16	Bank turn starboard		12	10	2

085

Table 12

SEQUENCE OF FELIX MANOEUVRES TRAINING

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
1	Take off		1	32	2
2	Forward flight	0.2 VNE	2	12	3
3	Forward flight	0.4 VNE	3	12	0
4	Control reversals	0.4 VNE	19	16	1
5	Forward flight	0.6 VNE	4	12	3
6	Control reversals	0.7 VNE	20	16	1
7	Forward flight	0.4 VNE	3	16	0
8	Control reversals	0.4 VNE	19	32	2
9	Control reversals	0.7 VNE	20	32	2
10	Forward flight	0.2 VNE	2	16	4
11	Transition to hover		8	9	1
12	Hover		9	54	6
13	Spot turns		15	16	1
14	Hover		9	45	5
15	Sideways flight starboard		13	24	4
16	Sideways flight port		12	24	4
17	Spot turns		15	16	1
18	Hover		9	27	3
19	Forward flight	0.2 VNE	2	12	3
20	Forward flight	0.4 VNE	3	12	0
21	Control reversals	0.4 VNE	19	32	2
22	Forward flight	0.6 VNE	4	12	3
23	Control reversals	0.7 VNE	20	32	2
24	Forward flight	0.8 VNE	5	30	0
25	Maximum power climb	70 kn	7	20	0
26	Forward flight	0.9 ÷ 1.1 VNE	6	180	30
27	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
28	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
29	Forward flight	0.9 ÷ 1.1 VNE	6	96	16
30	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
31	Forward flight	0.9 ÷ 1.1 VNE	6	324	54
32	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
33	Forward flight	0.9 ÷ 1.1 VNE	6	228	38
34	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
35	Forward flight	0.9 ÷ 1.1 VNE	6	156	26

$\sum$ = 1593 seconds

Table 12 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
36	Cruise turns 0.4 ÷ 0.8 VNE	10	24	6
37	Forward flight 0.9 ÷ 1.1 VNE	6	306	51
38	Curise turns 0.8 ÷ 1.0 VNE	11	4	1
39	Forward flight 0.9 ÷ 1.1 VNE	6	102	17
40	Cruise turns 0.4 ÷ 0.8 VNE	10	20	5
41	Forward flight 0.9 ÷ 1.1 VNE	6	30	5
42	Cruise turns 0.8 ÷ 1.0 VNE	11	4	1
43	Forward flight 0.9 ÷ 1.1 VNE	6	408	68
44	Cruise turns 0.4 ÷ 0.8 VNE	10	16	4
45	Forward flight 0.9 ÷ 1.1 VNE	6	42	7
46	0.75 hour flight marker	-1	-	-
47	Cruise turns 0.8 ÷ 1.0 VNE	11	4	1
48	Forward flight 0.9 ÷ 1.1 VNE	6	186	31
49	Descent	21	24	6
50	Forward flight 0.8 VNE	5	31	0
51	Control reversals 0.7 VNE	20	16	1
52	Forward flight 0.6 VNE	4	20	5
53	Forward flight 0.4 VNE	3	23	0
54	Control reversals 0.4 VNE	19	16	1
55	Forward flight 0.2 VNE	2	20	5
56	Transition to hover	8	18	2
57	Hover	9	54	6
58	Forward flight 0.2 VNE	2	12	3
59	Forward flight 0.4 VNE	3	12	0
60	Control reversals 0.4 VNE	19	16	1
61	Forward flight 0.6 VNE	4	32	8
62	Control reversals 0.7 VNE	20	16	1
63	Forward flight 0.4 VNE	3	24	0
64	Forward flight 0.2 VNE	2	12	3
65	Transition to hover	8	18	2
66	Hover	9	45	5
67	Forward flight 0.2 VNE	2	12	3
68	Forward flight 0.4 VNE	3	12	0
69	Control reversals 0.4 VNE	19	32	2
70	Forward flight 0.6 VNE	4	32	8

2549 seconds

$\sum$ = 3236 seconds

Table 12 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
71	Control reversals	0.7 VNE	20	32	2
72	Forward flight	0.4 VNE	3	24	0
73	Forward flight	0.2 VNE	2	12	3
74	Transition to hover		8	9	1
75	Hover		9	414	46
76	Spot turns		15	32	2
77	Forward flight	0.2 VNE	2	12	3
78	Forward flight	0.4 VNE	3	12	0
79	Control reversals	0.4 VNE	19	16	1
80	Forward flight	0.6 VNE	4	12	3
81	Control reversals	0.7 VNE	20	16	1
82	Forward flight	0.8 VNE	5	38	0
83	Maximum power climb	70 kn	7	17	0
84	Forward flight	0.9 ÷ 1.1 VNE	6	30	5
85	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
86	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
87	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
88	Forward flight	0.9 ÷ 1.1 VNE	6	186	31
89	Cruise turns	0.4 ÷ 0.8 VNE	10	20	5
90	Descent		21	24	6
91	Forward flight	0.8 VNE	5	38	0
92	Control reversals	0.7 VNE	20	16	1
93	Forward flight	0.6 VNE	4	16	4
94	Forward flight	0.4 VNE	3	17	0
95	Control reversals	0.4 VNE	19	16	1
96	Forward flight	0.2 VNE	2	12	3
97	Transition to hover		8	9	1
98	Hover		9	153	17
99	Forward flight	0.2 VNE	2	36	9
100	Transition to hover		8	9	1
101	Hover		9	495	55
102	Spot turns		15	16	1
103	Rearwards		14	15	5
104	Forward flight	0.2 VNE	2	12	3
105	Forward flight	0.4 VNE	3	12	0

$\sum$ = 5076 seconds

<u>Table 12</u> (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
106	Control reversals	0.4 VNE	19	32	2
107	Forward flight	0.6 VNE	4	16	4
108	Control reversals	0.7 VNE	20	32	2
109	Forward flight	0.8 VNE	5	46	0
110	Maximum power climb	70 kn	7	17	0
111	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
112	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
113	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
114	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
115	Forward flight	0.9 ÷ 1.1 VNE	6	72	12
116	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
117	Forward flight	0.9 ÷ 1.1 VNE	6	222	37
118	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
119	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
120	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
121	Forward flight	0.9 ÷ 1.1 VNE	6	462	77
122	Cruise turns	0.4 ÷ 0.8 VNE	10	20	5
123	Forward flight	0.9 ÷ 1.1 VNE	6	324	54
124	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
125	Forward flight	0.9 ÷ 1.1 VNE	6	96	16
126	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
127	Forward flight	0.9 ÷ 1.1 VNE	6	18	3
128	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
129	Forward flight	0.9 ÷ 1.1 VNE	6	510	85
130	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
131	Forward flight	0.9 ÷ 1.1 VNE	6	252	42
132	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
133	Forward flight	0.9 ÷ 1.1 VNE	6	108	18
134	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
135	Forward flight	0.9 ÷ 1.1 VNE	6	78	13
136	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
137	Forward flight	0.9 ÷ 1.1 VNE	6	306	51
138	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
139	Forward flight	0.9 ÷ 1.1 VNE	6	48	8
140	2.25 hour flight marker		-2	-	-

$\sum$ = 7949 seconds

085

Table 12 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
141	Cruise turns 0.8 ÷ 1.0 VNE	[illegible]	4	1
142	Forward flight 0.9 ÷ 1.1 VNE	[illegible]	402	67
143	Cruise turns 0.4 ÷ 0.8 VNE	[illegible]	16	4
144	Forward flight 0.9 ÷ 1.1 VNE	6	24	4
145	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
146	Forward flight 0.9 ÷ 1.1 VNE	6	12	2
147	Cruise turns 0.4 ÷ 0.8 VNE	10	16	4
148	Forward flight 0.9 ÷ 1.1 VNE	6	18	3
149	Cruise turns 0.8 ÷ 1.0 VNE	11	4	1
150	Forward flight 0.9 ÷ 1.1 VNE	6	36	6
151	Cruise turns 0.4 ÷ 0.8 VNE	10	16	4
152	Forward flight 0.9 ÷ 1.1 VNE	6	12	2
153	Cruise turns 0.8 ÷ 1.0 VNE	11	4	1
154	Froward flight 0.9 ÷ 1.1 VNE	[illegible]	48	8
155	Cruise turns 0.8 ÷ [illegible] VNE	11	4	1
156	Forward flight 0.9 ÷ [illegible] 1 VNE	6	12	2
157	Cruise turns 0.4 ÷ 0.8 VNE	10	16	4
158	Forward flight 0.9 ÷ 1.1 VNE	6	474	79
159	Autorotation	16	24	2
160	Autorotation	17	12	1
161	Autorotation	16	24	2
162	Recoveries from autorotation	18	7	1
163	Forward flight 0.8 VNE	5	161	0
164	Control reversals 0.7 VNE	20	32	2
165	Forward flight 0.6 VNE	4	24	6
166	Forward flight 0.4 VNE	3	24	0
167	Control reversals 0.4 VNE	19	32	2
168	Forward flight 0.2 VNE	2	12	3
169	Transition to hover	8	9	1
170	Hover	9	117	13
171	Forward flight 0.2 VNE	2	84	21
172	Transition to hover	8	9	1
173	Hover	9	549	61
174	Sideways flight portside	12	18	3
175	Rearwards	14	27	9

$\sum$ = 10244 seconds

Table 12 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
176	Spot turns		15	32	2
177	Hover		9	306	34
178	Sideways flight starboard		13	18	3
179	Spot turns		15	16	1
180	Rearwards		14	27	9
181	Hover		9	216	24
182	Forward flight	0.2 VNE	2	12	3
183	Forward flight	0.4 VNE	3	12	0
184	Control reversals	0.4 VNE	19	32	2
185	Forward flight	0.6 VNE	4	12	3
186	Control reversals	0.7 VNE	20	32	2
187	Forward flight	0.8 VNE	5	46	0
188	Maximum power climb	70 kn	7	12	0
189	Forward flight	0.9 ÷ 1.1 VNE	6	18	6
190	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
191	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
192	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
193	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
194	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
195	Forward flight	0.9 ÷ 1.1 VNE	6	288	48
196	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
197	Forward flight	0.9 ÷ 1.1 VNE	6	450	75
198	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
199	Forward flight	0.9 ÷ 1.1 VNE	6	150	25
200	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
201	Forward flight	0.9 ÷ 1.1 VNE	6	372	62
202	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
203	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
204	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
205	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
206	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
207	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
208	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
209	Forward flight	0.9 ÷ 1.1 VNE	6	180	30
210	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1

Table 12 (concluded)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
211	Forward flight	0.9 ÷ 1.1 VNE	6	306	51
212	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
213	Forward flight	0.9 ÷ 1.1 VNE	6	318	53

$\sum$ = 13349 seconds

	Landing sequence marker		-	-	-
214	Descent		21	20	5
215	Forward flight	0.8 VNE	5	24	0
216	Forward flight	0.6 VNE	4	20	5
217	Forward flight	0.4 VNE	3	12	0
218	Forward flight	0.2 VNE	2	16	4
219	Transition to hover		8	9	1
220	Hover		9	18	2
221	Spot turns		15	16	1
222	Landing		22	16	1

$\sum$ = 13500 seconds

085

Table 13

SEQUENCE OF FELIX MANOEUVRES TRANSPORT

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
1	Take off		1	32	2
2	Forward flight	0.2 VNE	2	12	3
3	Forward flight	0.4 VNE	3	12	0
4	Control reversals	0.4 VNE	19	64	4
5	Forward flight	0.6 VNE	4	8	2
6	Control reversals	0.7 VNE	20	64	4
7	Forward flight	0.8 VNE	5	174	0
8	Maximum power climb	70 kn	7	58	0
9	Forward flight	0.9 ÷ 1.1 VNE	6	882	147
10	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
11	Forward flight	0.9 ÷ 1.1 VNE	6	150	25
12	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
13	Forward flight	0.9 ÷ 1.1 VNE	6	114	19
14	0.75 hour flight marker		-1	-	-
15	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
16	Forward flight	0.9 ÷ 1.1 VNE	6	492	82
17	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
18	Forward flight	0.9 ÷ 1.1 VNE	6	576	96
19	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
20	Forward flight	0.9 ÷ 1.1 VNE	6	654	109
21	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
22	Forward flight	0.9 ÷ 1.1 VNE	6	162	27
23	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
24	Forward flight	0.9 ÷ 1.1 VNE	6	288	48
25	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
26	Forward flight	0.9 ÷ 1.1 VNE	6	102	17
27	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
28	Forward flight	0.9 ÷ 1.1 VNE	6	252	42
29	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
30	Forward flight	0.9 ÷ 1.1 VNE	6	60	10
31	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
32	Forward flight	0.9 ÷ 1.1 VNE	6	312	52
33	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
34	Forward flight	0.9 ÷ 1.1 VNE	6	60	10
35	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1

1578 seconds

$\sum$ = 4628 seconds

Table 13 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
36	Forward flight	0.9 ÷ 1.1 VNE	6	372	62
37	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
38	Forward flight	0.9 ÷ 1.1 VNE	6	390	65
39	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
40	Forward flight	0.9 ÷ 1.1 VNE	6	78	13
41	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
42	Forward flight	0.9 ÷ 1.1 VNE	6	48	8
43	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
44	Forward flight	0.9 ÷ 1.1 VNE	6	714	119
45	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
46	Forward flight	0.9 ÷ 1.1 VNE	6	162	27
47	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
48	Forward flight	0.9 ÷ 1.1 VNE	6	174	29
49	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
50	Forward flight	0.9 ÷ 1.1 VNE	6	384	64
51	2.25 hour flight marker		-2	-	-
52	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
53	Forward flight	0.9 ÷ 1.1 VNE	6	342	57
54	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
55	Forward flight	0.9 ÷ 1.1 VNE	6	228	38
56	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
57	Forward flight	0.9 ÷ 1.1 VNE	6	366	61
58	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
59	Forward flight	0.9 ÷ 1.1 VNE	6	360	60
60	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
61	Forward flight	0.9 ÷ 1.1 VNE	6	288	48
62	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
63	Forward flight	0.9 ÷ 1.1 VNE	6	180	30
64	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
65	Forward flight	0.9 ÷ 1.1 VNE	6	246	41
66	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
67	Forward flight	0.9 ÷ 1.1 VNE	6	234	39
68	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
69	Forward flight	0.9 ÷ 1.1 VNE	6	96	16
70	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1

6978 seconds

$\sum$ = 9358 seconds

085

Table 13 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
71	Forward flight	0.9 ÷ 1.1 VNE	6	156	26
72	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
73	Forward flight	0.9 ÷ 1.1 VNE	6	24	6
74	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
75	Forward flight	0.9 ÷ 1.1 VNE	6	192	32
76	Cruise turns	0.9 ÷ 1.0 VNE	11	4	1
77	Forward flight	0.9 ÷ 1.1 VNE	6	156	26
78	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
79	Forward flight	0.8 ÷ 1.1 VNE	6	336	56
80	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
81	Forward flight	0.9 ÷ 1.1 VNE	6	384	64
82	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
83	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
84	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
85	Forward flight	0.9 ÷ 1.1 VNE	6	33	56
86	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
87	Forward flight	0.9 ÷ 1.1 VNE	6	114	19
88	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
89	Forward flight	0.9 ÷ 1.1 VNE	6	102	17
90	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
91	Forward flight	0.9 ÷ 1.1 VNE	6	90	15
92	Autorotation		16	24	2
93	Autorotation		17	12	1
94	Autorotation		16	24	2
95	Recoveries from autorotation		18	7	1
96	Descent		21	24	6
97	Forward flight	0.8 VNE	5	176	0
98	Control reversals	0.7 VNE	20	80	5
99	Forward flight	0.6 VNE	4	12	3
100	Forward flight	0.4 VNE	3	11	0
101	Control reversals	0.4 VNE	19	80	5
102	Forward flight	0.2 VNE	2	12	3
103	Transition to hover		8	9	1
104	Hover		9	279	31
105	Forward flight	0.2 VNE	2	12	3

Table 13 (concluded)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
106	Forward flight	0.4 VNE	3	12	0
107	Control reversals	0.4 VNE	19	64	4
108	Forward flight	0.6 VNE	4	12	3
109	Control reversals	0.7 VNE	20	64	4
110	Forward flight	0.8 VNE	5	140	0

$\sum$ = 12378 seconds

-	Landing sequence marker		-	-	-
111	Descent		21	12	3
112	Forward flight	0.8 VNE	5	609	0
113	Control reversals	0.7 VNE	20	64	4
114	Forward flight	0.6 VNE	4	20	5
115	Forward flight	0.4 VNE	3	16	0
116	Control reversals	0.4 VNE	19	64	4
117	Forward flight	0.2 VNE	2	16	4
118	Transition to hover		8	9	1
119	Hover		9	90	10
120	Sideways flight portside		12	42	7
121	Spot turns		15	32	2
122	Rearwards		14	42	14
123	Sideways flight starboard		13	42	7
124	Spot turns		15	32	2
125	Landing		22	32	2

$\sum$ = 13500 seconds

Table 14

SEQUENCE OF FELIX MANOEUVRES ASW

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
1	Take off		1	16	1
2	Forward flight	0.2 VNE	2	12	3
3	Forward flight	0.4 VNE	3	11	0
4	Control reversals	0.4 VNE	19	16	1
5	Forward flight	0.6 VNE	4	12	3
6	Control reversals	0.7 VNE	20	16	1
7	Forward flight	0.8 VNE	5	21	0
8	Maximum power climb	70 kn	7	11	0
9	Forward flight	0.9 ÷ 1.1 VNE	6	48	8
10	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
11	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
12	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
13	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
14	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
15	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
16	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
17	Forward flight	0.9 ÷ 1.1 VNE	6	60	10
18	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
19	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
20	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
21	Forward flight	0.9 ÷ 1.1 VNE	6	60	10
22	Cruise turns	0.8 ÷ 1.0 VNE	11	12	3
23	Forward flight	0.9 ÷ 1.1 VNE	6	18	3
24	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
25	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
26	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
27	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
28	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
29	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
30	Cruise turns	0.8 ÷ 1.1 VNE	11	8	2
31	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
	1 Sonar dunk		-	-	-
32	Descent		21	12	3
33	Forward flight	0.8 VNE	5	20	0
34	Forward flight	0.6 VNE	4	8	2

$\sum =$ 731 seconds

085

Table 14 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
35	Forward flight	0.4 VNE	3	10	0
36	Forward flight	0.2 VNE	2	12	3
37	Transition to hover		8	9	1
38	Hover		9	225	25
39	1 Combined manoeuvre		25	150	1
	2 Sonar dunk		-	-	-
40	Descent		21	12	3
41	Forward flight	0.8 VNE	5	20	0
42	Forward flight	0.6 VNE	4	8	2
43	Forward flight	0.4 VNE	3	10	0
44	Forward flight	0.2 VNE	2	12	3
45	Transition to hover		8	9	1
46	Hover		9	153	17
47	2 Combined manoeuvre		25	150	1
	3 Sonar dunk		-	-	-
48	Descent		21	8	2
49	Forward flight	0.8 VNE	5	21	0
50	Forward flight	0.6 VNE	4	12	3
51	Forward flight	0.4 VNE	3	11	0
52	Forward flight	0.2 VNE	2	8	2
53	Transition to hover		8	9	1
54	Hover		9	90	10
55	3 Combined manoeuvre		25	150	1
56	Forward flight	0.9 ÷ 1.1 VNE	6	66	11
57	Cruise turns	0.8 ÷ 1.0 VNE	11	12	3
58	Forward flight	0.9 ÷ 1.1 VNE	6	66	11
59	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
60	0.75 hour flight marker		-1	-	-

$\sum$ = 1976 seconds

	4 Sonar dunk		-	-	-
61	Descent		21	8	2
62	Forward flight	0.8 VNE	5	20	0
63	Forward flight	0.6 VNE	4	12	3
64	Forward flight	0.4 VNE	3	10	0

085

Table 14 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
65	Forward flight	0.2 VNE	2	12	3
66	Transition to hover		8	18	2
67	Hover		9	288	32
68	4 Combined manoeuvre		25	150	1
69	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
70	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
71	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
72	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
73	Forward flight	0.9 ÷ 1.1 VNE	6	60	10
74	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
75	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
76	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
77	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
78	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
79	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
80	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
	5 Sonar dunk		-	-	-
81	Descent		21	8	2
82	Forward flight	0.8 VNE	5	20	0
83	Forward flight	0.6 VNE	4	12	3
84	Forward flight	0.4 VNE	3	10	0
85	Forward flight	0.2 VNE	2	8	2
86	Transition to hover		8	18	2
87	Hover		9	459	51
88	5 Combined manoeuvre		25	150	1
89	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
90	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
91	Forward flight	0.9 ÷ 1.1 VNE	6	18	3
92	Cruise turns	0.4 ÷ 0.8 VNE	10	16	4
93	Forward flight	0.9 ÷ 1.1 VNE	6	30	5
94	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
95	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
96	Cruise turns	0.8 ÷ 1.0 VNE	11	12	3
	6 Sonar dunk		-	-	-
97	Descent		21	8	2

$\sum$ = 3661 seconds

Table 14 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
98	Forward flight	0.8 VNE	5	20	0
99	Forward flight	0.6 VNE	4	12	3
100	Forward flight	0.4 VNE	3	10	0
101	Forward flight	0.2 VNE	2	12	3
102	Transition to hover		8	18	2
103	Hover		9	369	41
104	6 Combined manoeuvre		25	150	1
105	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
106	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
197	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
108	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
109	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
110	Cruise turns	0.8 ÷ 1.0 VNE	11	12	3
111	Forward flight	0.9 ÷ 1.1 VNE	6	48	8
112	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
	7 Sonar dunk		-	-	-
113	Descent		21	12	3
114	Forward flight	0.8 VNE	5	20	0
115	Forward flight	0.6 VNE	4	8	2
116	Forward flight	0.4 VNE	3	10	0
117	Forward flight	0.2 VNE	2	12	3
118	Transition to hover		8	18	2
119	Hover		9	324	36
120	7 Combined manoeuvre		25	150	1
121	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
122	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
123	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
124	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
125	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
126	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
127	Forward flight	0.9 ÷ 1.1 VNE	6	60	10
128	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
129	Forward flight	0.9 ÷ 1.1 VNE	6	60	10
130	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3

$\sum$ = 5306 seconds

085

Table 14 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
	8 Sonar dunk		-	-	-
131	Descent		21	8	2
132	Forward flight	0.8 VNE	5	20	0
133	Control reversals	0.7 VNE	20	16	1
134	Forward flight	0.6 VNE	4	12	3
135	Forward flight	0.4 VNE	3	10	0
136	Control reversals	0.4 VNE	19	16	1
137	Forward flight	0.2 VNE	2	12	3
138	Transition to hover		8	9	1
139	Hover		9	396	44
140	8 Combined manoeuvre		25	150	1
141	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
142	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
143	Forward flight	0.9 ÷ 1.1 VNE	6	30	5
144	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
145	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
146	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
147	Forward flight	0.9 ÷ 1.1 VNE	6	30	5
148	Cruise turns	0.8 ÷ 1.0 VNE	11	12	3
149	Forward flight	0.9 ÷ 1.1 VNE	6	30	5
150	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
151	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
152	Cruise turns	0.8 ÷ 1.0 VNE	11	12	3
153	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
154	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
155	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
156	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
	9 Sonar dunk		-	-	-
157	Descent		21	8	2
158	Forward flight	0.8 VNE	5	20	0
159	Forward flight	0.6 VNE	4	12	3
160	Forward flight	0.4 VNE	3	10	0
161	Forward flight	0.2 VNE	2	12	3
162	Transition to hover		8	9	1
163	Hover		9	378	42

$\sum$ = 6772 seconds

085

Table 14 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
164	9 Combined manoeuvre	25	150	1
165	Forward flight 0.9 : 1.1 VNE	6	12	2
166	Cruise turns 0.4 : 0.8 VNE	10	12	3
167	Forward flight 0.9 : 1.1 VNE	6	12	2
168	Cruise turns 0.8 : 1.0 VNE	11	8	2
169	Forward flight 0.9 : 1.1 VNE	6	78	13
170	Cruise turns 0.4 : 0.8 VNE	10	12	3
171	Forward flight 0.9 : 1.1 VNE	6	36	6
172	Cruise turns 0.8 : 1.0 VNE	11	8	2
173	Forward flight 0.9 : 1.1 VNE	6	36	6
174	Cruise turns 0.4 : 0.8 VNE	10	8	2
175	Forward flight 0.9 : 1.1 VNE	6	6	1
176	Cruise turns 0.8 : 1.0 VNE	11	8	2
177	Forward flight 0.9 : 1.1 VNE	6	48	8
178	Cruise turns 0.4 : 0.8 VNE	10	12	3
179	Forward flight 0.9 : 1.1 VNE	6	24	4
180	Cruise turns 0.4 : 0.8 VNE	10	12	3
181	Forward flight 0.9 : 1.1 VNE	6	18	3
182	Cruise turns 0.4 : 0.8 VNE	10	12	3
183	Forward flight 0.9 : 1.1 VNE	6	36	6
184	Cruise turns 0.4 : 0.8 VNE	10	12	3
185	Forward flight 0.9 : 1.1 VNE	6	12	2
186	Cruise turns 0.4 : 0.8 VNE	10	12	3
187	Forward flight 0.9 : 1.1 VNE	6	12	2
188	Cruise turns 0.4 : 0.8 VNE	10	8	2
189	2.25 hours flight marker	-2	-	-

$\sum$ = 7376 seconds

	10 Sonar dunk	-	-	-
190	Descent	21	12	3
191	Forward flight 0.8 VNE	5	21	0
192	Forward flight 0.6 VNE	4	8	2
193	Forward flight 0.4 VNE	3	11	0
194	Forward flight 0.2 VNE	2	8	2
195	Transition to hover	8	9	1

Table 14 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
196	Hover	9	189	21
197	10 Combined manoeuvre	25	150	1
198	Forward flight 0.9 ÷ 1.1 VNE	6	60	10
199	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
200	Forward flight 0.9 ÷ 1.1 VNE	6	30	5
201	Cruise turns 0.8 ÷ 1.0 VNE	11	8	2
202	Forward flight 0.9 ÷ 1.1 VNE	6	48	8
203	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
204	Forward flight 0.9 ÷ 1.1 VNE	6	24	4
205	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
	11 Sonar dunk	-	-	-
206	Descent	21	12	3
207	Forward flight 0.8 VNE	5	22	0
208	Forward flight 0.6 VNE	4	12	3
209	Forward flight 0.4 VNE	3	11	0
210	Forward flight 0.2 VNE	2	8	2
211	Transition to hover	8	9	1
212	Hover	9	288	32
213	11 Combined manoeuvre	25	150	1
214	Forward flight 0.9 ÷ 1.1 VNE	6	36	6
215	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
216	Forward flight 0.9 ÷ 1.1 VNE	6	42	7
217	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
218	Forward flight 0.9 ÷ 1.1 VNE	6	30	5
219	Cruise turns 0.4 ÷ 0.8 VNE	10	8	2
220	Forward flight 0.9 ÷ 1.1 VNE	6	36	6
221	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
222	Forward flight 0.9 ÷ 1.1 VNE	6	72	12
223	Cruise turns 0.4 ÷ 0.8 VNE	10	8	2
224	Forward flight 0.9 ÷ 1.1 VNE	6	66	11
225	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
226	Forward flight 0.9 ÷ 1.1 VNE	6	30	5
227	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
	12 Sonar dunk	-	-	-
228	Descent	21	8	2

$\sum$ = 8898 seconds

Table 14 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
229	Forward flight	0.8 VNE	5	23	0
230	Forward flight	0.6 VNE	4	12	3
231	Forward flight	0.4 VNE	3	11	0
232	Forward flight	0.2 VNE	2	12	3
233	Transition to hover		8	9	1
234	Hover		9	198	22
235	12 Combined manoeuvre		25	150	1
236	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
237	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
238	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
239	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
240	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
241	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
242	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
243	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
244	Forward flight	0.9 ÷ 1.1 VNE	6	30	5
245	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
	13 <u>Sonar dunk</u>		-	-	-
246	Descent		21	8	2
247	Forward flight	0.8 VNE	5	23	0
248	Control reversals	0.7 VNE	20	16	1
249	Forward flight	0.6 VNE	4	12	3
250	Forward flight	0.4 VNE	3	11	0
251	Control reversals	0.4 VNE	19	16	1
252	Forward flight	0.2 VNE	2	12	3
253	Transition to hover		8	9	1
254	Hover		9	351	39
255	13 Combined manoeuvre		25	150	1
256	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
257	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
258	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
259	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
260	Forward flight	0.9 ÷ 1.1 VNE	6	18	3
261	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
262	Forward flight	0.9 ÷ 1.1 VNE	6	6	1

$\sum$ = 10281 seconds

085

Table 14 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
263	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
264	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
265	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
266	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
267	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
268	Forward flight	0.9 ÷ 1.1 VNE	6	30	5
269	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
290	Forward flight	0.9 ÷ 1.1 VNE	6	48	8
271	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
272	Forward flight	0.9 ÷ 1.1 VNE	6	42	7
273	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
	14 Sonar dunk		-	-	-
274	Descent		21	8	2
275	Forward flight	0.8 VNE	5	22	0
276	Forward flight	0.6 VNE	4	12	3
277	Forward flight	0.4 VNE	3	10	0
278	Forward flight	0.2 VNE	2	12	3
279	Transition to hover		8	9	1
280	Hover		9	279	31
281	14 Combined manoeuvre		25	150	1
282	Forward flight	0.9 ÷ 1.1 VNE	6	6	1
283	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
284	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
285	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
286	Forward flight	0.9 ÷ 1.1 VNE	6	84	14
287	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
288	Forward flight	0.9 ÷ 1.1 VNE	6	66	11
289	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
290	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
291	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
292	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
293	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
294	Forward flight	0.9 ÷ 1.1 VNE	6	36	6
295	Cruise turns	0.8 ÷ 1.0 VNE	11	8	2
296	Forward flight	0.9 ÷ 1.1 VNE	6	54	9

$\sum$ = 11419 seconds

085

Table 14 (continued)

Position number	Manoeuvre	Manoeuvre number	Time in manoeuvre (s)	Matrix applications
297	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
298	Forward flight 0.9 : 1.1 VNE	6	30	5
299	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
300	Forward flight 0.9 ÷ 1.1 VNE	6	108	18
301	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
302	Forward flight 0.9 ÷ 1.1 VNE	6	30	5
303	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
304	Forward flight 0.9 ÷ 1.1 VNE	6	18	3
305	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
306	Forward flight 0.9 ÷ 1.1 VNE	6	42	7
307	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
308	Forward flight 0.9 ÷ 1.1 VNE	6	18	3
309	Cruise turns 0.8 ÷ 1.0 VNE	11	12	3
310	Forward flight 0.9 ÷ 1.1 VNE	6	30	5
311	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
312	Forward flight 0.9 ÷ 1.1 VNE	6	42	7
313	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
314	Forward flight 0.9 ÷ 1.1 VNE	6	18	3
315	Cruise turns 0.8 ÷ 1.0 VNE	11	8	2
316	Forward flight 0.9 ÷ 1.1 VNE	6	42	7
317	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
318	Forward flight 0.9 ÷ 1.1 VNE	6	42	7
319	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
320	Forward flight 0.9 ÷ 1.1 VNE	6	60	10
321	Cruise turns 0.8 ÷ 1.0 VNE	11	8	2
322	Forward flight 0.9 ÷ 1.1 VNE	6	30	5
323	Cruise turns 0.8 ÷ 1.0 VNE	11	8	2
324	Forward flight 0.9 ÷ 1.1 VNE	6	30	5
325	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
326	Forward flight 0.9 ÷ 1.1 VNE	6	60	10
327	Cruise turns 0.8 ÷ 1.0 VNE	11	12	3
328	Forward flight 0.9 ÷ 1.1 VNE	6	102	17
329	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3
330	Forward flight 0.9 ÷ 1.1 VNE	6	18	3
331	Cruise turns 0.4 ÷ 0.8 VNE	10	12	3

$\sum$ = 12343 seconds

Table 14 (concluded)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
332	Forward flight	0.9 ÷ 1.1 VNE	6	72	12
333	Cruise turns	0.8 ÷ 1.0 VNE	11	12	3
334	Forward flight	0.9 ÷ 1.1 VNE	6	24	4
335	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
336	Forward flight	0.9 ÷ 1.1 VNE	6	54	9
337	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
338	Forward flight	0.9 ÷ 1.1 VNE	6	66	11
339	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
340	Forward flight	0.9 ÷ 1.1 VNE	6	18	3
341	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
342	Forward flight	0.9 ÷ 1.1 VNE	6	60	10
343	Cruise turns	0.4 ÷ 0.8 VNE	10	12	3
344	Autorotation		16	24	2
345	Autorotation		17	12	1
346	Autorotation		16	24	2
347	Recoveries from autorotation		18	7	1

$\sum$ = 12776 seconds

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
	Landing sequence marker		–	–	–
348	Descent		21	40	10
349	Forward flight	0.8 VNE	5	106	0
350	Forward flight	0.6 VNE	4	28	7
351	Forward flight	0.4 VNE	3	28	0
352	Forward flight	0.2 VNE	2	28	7
353	Transition to hover		8	18	2
354	Hover		9	270	30
355	Sideways flight portside		12	42	7
356	Spot turns		15	32	2
357	Rearwards		14	42	14
358	Sideways flight starboard		13	42	7
359	Spot turns		15	32	2
360	Landing		22	16	1

$\sum$ = 13500 seconds

Table 15

SEQUENCE OF FELIX MANOEUVRES SAR

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications	
1	Take off		1	32	2	
2	Forward flight	0.2 VNE	2	8	2	
3	Forward flight	0.4 VNE	3	6	0	
4	Control reversals	0.4 VNE	19	64	4	
5	Forward flight	0.6 VNE	4	8	2	
6	Control reversals	0.7 VNE	20	64	4	546 seconds
7	Forward flight	0.8 VNE	5	31	0	
8	Maximum power climb	70 kn	7	29	0	
9	Forward flight	0.9 ÷ 1.1 VNE	6	192	32	
10	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1	
11	Forward flight	0.9 ÷ 1.1 VNE	6	108	18	
12	First 0.75 hour flight marker		-1	-	-	
13	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1	
14	Forward flight	0.9 ÷ 1.1 VNE	6	552	92	
15	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2	
16	Forward flight	0.9 ÷ 1.1 VNE	6	318	53	
17	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1	
18	Forward flight	0.9 ÷ 1.1 VNE	6	156	26	
19	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1	
20	Forward flight	0.9 ÷ 1.1 VNE	6	114	19	
21	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1	3534 seconds
22	Forward flight	0.9 ÷ 1.1 VNE	6	258	43	
23	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1	
24	Forward flight	0.9 ÷ 1.1 VNE	6	300	50	
25	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2	
26	Forward flight	0.9 ÷ 1.1 VNE	6	378	63	
27	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1	
28	Forward flight	0.9 ÷ 1.1 VNE	6	606	101	
29	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1	
30	Forward flight	0.9 ÷ 1.1 VNE	6	258	43	
31	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1	
32	First 2.25 hour flight marker		-2	-	-	
33	Forward flight	0.9 ÷ 1.1 VNE	6	312	52	
34	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1	
35	Forward flight	0.9 ÷ 1.1 VNE	6	642	107	

Table 15 (continued)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
36	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1
37	Forward flight	0.9 ÷ 1.1 VNE	6	234	39
38	Descent		21	16	4
39	Forward flight	0.8 VNE	5	1982	0

$\sum$ = 6728 seconds

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
-	SAR marker		-	-	-
40	Descent		21	20	5
41	Forward flight	0.8 VNE	5	380	0
42	Control reversals	0.7 VNE	20	64	4
43	Forward flight	0.6 VNE	4	8	2
44	Forward flight	0.4 VNE	3	5	0
45	Control reversals	0.4 VNE	19	64	4
46	Forward flight	0.2 VNE	2	8	2
47	Transition to hover		8	9	1
48	Hover		9	585	65
49	Sideways flight portside		12	42	7
50	Rearwards		14	42	14
51	Spot turns		15	48	3
52	Forward flight	0.2 VNE	2	8	2
53	Forward flight	0.4 VNE	3	5	0
54	Control reversals	0.4 VNE	19	80	5
55	Forward flight	0.6 VNE	4	8	2
56	Control reversals	0.7 VNE	20	80	5
57	Forward flight	0.8 VNE	5	61	0
58	Maximum power climb	70 kn	7	29	0
59	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
60	Forward flight	0.9 ÷ 1.1 VNE	6	294	49
61	Second 0.75 hour flight marker		-1	-	-
62	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
63	Forward flight	0.9 ÷ 1.1 VNE	6	678	113
64	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
65	Forward flight	0.9 ÷ 1.1 VNE	6	228	38
66	Cruise turns	0.8 ÷ 1.0 VNE	11	4	1

8572 seconds

Table 15 (concluded)

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
67	Forward flight	0.9 ÷ 1.1 VNE	6	354	59
68	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
69	Forward flight	0.9 ÷ 1.1 VNE	6	828	138
70	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
71	Forward flight	0.9 ÷ 1.1 VNE	6	288	48
72	Second 2.25 hour flight marker		-2	-	-
73	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
74	Forward flight	0.9 ÷ 1.1 VNE	6	504	84
75	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
76	Forward flight	0.9 ÷ 1.1 VNE	6	402	67
77	Cruise turns	0.4 ÷ 0.8 VNE	10	4	1
78	Forward flight	0.9 ÷ 1.1 VNE	6	396	66
79	Descent		21	16	4
80	Forward flight	0.8 VNE	5	872	0

←11984 seconds

$\sum$ = 13190 seconds

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
	Landing sequence marker		-	-	-
81	Descent		21	16	4
82	Forward flight	0.8 VNE	5	29	0
83	Control reversals	0.7 VNE	20	64	4
84	Forward flight	0.6 VNE	4	4	1
85	Forward flight	0.4 VNE	3	10	0
86	Control reversals	0.4 VNE	19	64	4
87	Forward flight	0.2 VNE	2	4	1
88	Transition to hover		8	9	1
89	Hover		9	36	4
90	Sideways flight starboard		13	42	7
91	Spot turns		15	16	1
92	Landing		22	16	1

$\sum$ = 13500 seconds

085

Table 16

SEQUENCE OF FELIX MANOEUVRES ASW COMBINED

Position number	Manoeuvre		Manoeuvre number	Time in manoeuvre (s)	Matrix applications
1	Forward flight	0.2 VNE	2	12	3
2	Forward flight	0.4 VNE	3	12	0
3	Control reversals	0.4 VNE	19	16	1
4	Forward flight	0.6 VNE	4	12	3
5	Control reversals	0.7 VNE	20	16	1
6	Forward flight	0.8 VNE	5	24	0
7	Maximum power climb	70 kn	7	12	0
8	Forward flight	0.9 ÷ 1.1 VNE	6	18	3
9	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2
10	Forward flight	0.9 ÷ 1.1 VNE	6	12	2
11	Cruise turns	0.4 ÷ 0.8 VNE	10	8	2

$\sum$ = 150 seconds

085

Table 17

EQUIVALENCE OF HELIX AND FELIX MANOEUVRES

Helix		Felix		
No	Manoeuvre	No	Manoeuvre	Included manoeuvres
1	Take off	1	Take off	Rapid increase rev/min Take off
2	Forward flight 20 kn	2	Forward flight 0.2 VNE	
3	Forward flight 30 kn	3	Forward flight 0.4 VNE	
4	Forward flight 40 kn	4	Forward flight 0.6 VNE	
5	Forward flight 60 kn	5	Forward flight 0.8 VNE	
6	Forward flight 103 kn	6	Forward flight 0.9 : 1.1 VNE	fw. fl. 0.9 : 1.0 VNE fw. fl. 1.1 VNE
7	Maximum power climb 70 kn	7	Maximum power climb 70 kn	
8 9	Shallow appr. to hover Normal appro. to hover	8	Transition to hover	Transition to hover Flare
10	Hover	9	Hover	Steady hovering Transition from hover
11	Bank turn port VNO	10	Cruise turns 0.4 : 0.8 VNE	
12	Bank turn starboard VNO	11	Cruise turns 0.8 : 1.0 VNE	
13 14	Sideways flight port Recovery from 13	12	Sideways flight port	
15 16	Sideways flight starboard Recovery from 15	13	Sideways flight starboard	
17 18	Rearwards flight Recovery from 17	14	Rearwards	
19 20	Spot turn port Spot turn starboard	15	Spot turns	
21	Autorotation	16 (17	Autorotation (AR) AR incl. large amplitudes	Entries into AR Steady flight AR Control rev. longit. AR Control rev. lateral AR Control rev. yawing AR Right turn AR Left turn AR Collective pull up AR
22	Recovery from 21	18	Recoveries from AR	
No equivalence		19	Control reversals 0.4 VNE (to be interspersed during forward flights)	Longitudinal Lateral Yawing Collective
No equivalence		20	Control reversals 0.7 VNE (to be interspersed during forward flights)	Longitudinal Lateral Yawing Collective
23	Descent	21	Descent	
24	Landing	22	Landing	

Table 18

SEQUENCE OF LOADS FOR EACH FUNDAMENTAL MANOEUVRES IN HELIX/32 (HELIX UNITS)

NOTE : first number represents mean load

1 Take off

44 20

2 Forward flight 20 kn

72 20

3 Forward flight 30 kn

68 28

4 Forward flight 40 kn

60 28

5 Forward flight 60 kn

60 24

6 Forward flight 103 kn

64 28

7 Maximum power climb

68 20

8 Shallow approach to hover

56 32 32 36 36 32 32 36 32 36 32 32 32

9 Normal approach to hover

60 36 36 36 36 40 32 32 32 36

10 Hover

No significant loads

11 Bank turn port 30° Vno

68 32

12 Bank turn starboard 30° Vno

68 32

13 Sideways flight port

56 20

14 Recovery from sideways flight to port

52 36 32 36

15 Sideways flight to starboard

60 28

Table 18 (concluded)

16 Recovery from sideways flight to starboard

52 36 36 32 40 36 36 32

17 Rearwards flight 20 kn

68 20

18 Recovery from rearwards flight

60 32 32 32 36 32 32 32 32 32 32 32

19 Spot turn port

64 28

20 Spot turn starboard

68 20

21 Autorotation

60 20

22 Recovery from autorotation

60 32 36 32 32 32

23 Descent

60 24

24 Landing

72 28

Table 19

SEQUENCE OF LOADS FOR EACH FUNDAMENTAL MANOEUVRE IN FELIX/28 (FELIX UNITS)

NOTE : first number represents mean load

1 Take off

32 28 28 28 28 28 28 28 28 28 32 28 28

2 Forward flight at 0.2 Vne

48 24

3 Forward flight at 0.4 Vne

No significant loads

4 Forward flight at 0.6 Vne

48 16

5 Forward flight at 0.8 Vne

No significant loads

6 Forward flight at 0.9 - 1.1 Vne

48 24

7 Maximum power climb 70 kn

No significant loads

8 Transition to hover

40 24

9 Hover

36 24

10 Cruise turns 0.4 - 0.8 Vne

60 24

11 Cruise turns 0.8 - 1.0 Vne

64 28

12 Sideways flight port

36 24

13 Sideways flight starboard

36 28 28 28 28 28 28 32 28 28 28 28 28 28 28

14 Rearwards flight

36 28

15 Spot turns

36 24

085

Table 19 (concluded)

16 Autorotation

40 32 28 32 28 28 36 28 28 44 28 28 28 32 28

17 Autorotation in 3.75 hour flights only

40 32 28 32 28 48 28 36 60 28 28 52 44 28 48 60
60 28 28 48 32 28

18 Recoveries from autorotation

36 24

19 Control reversals 0.4 Vne

36 28 28 36 32 28 32 32 28 28

20 Control reversals 0.7 Vne

44 36 32 28 36 32 28 28 28 28 32

21 Descent

36 28 28 28 28 28 28 28 32 28 28 28 28 28 28 28
28 28 28 28 28 28 32 28 28 28 28 28 28

22 Landing

8 36 36

Table 20

NUMBERS OF FULL CYCLES IN HELIX AND FELIX
BOTH IN FULL AND SHORTENED FORM

Sequence	Number of whole cycles
Helix	2132024
Helix/32	145862
Felix	2285072
Felix/28	161034

Table 21

HELIX RAINFLOW ANALYSIS

Distribution of the ranges

Range size (Helix units)	Number of ranges	Cumulative number	Average mean (Helix units)
4	5988	4264048	65.5
8	1312	4258060	62.3
12	554	4256748	66.0
16	138	4256194	64.0
20	280	4256056	62.0
24	0	4255776	-
28	554	4255776	66.0
32	0	4255222	-
36	464	4255222	59.2
40	959084	4254758	62.2
44	738	3295674	62.4
48	910654	3294936	63.6
52	7176	2384282	65.4
56	2336362	2377106	64.2
60	4452	40744	65.7
64	20658	36292	61.8
68	542	15634	57.2
72	11796	15092	57.7
76	830	3296	58.4
80	1884	2466	58.5
84	20	582	58.0
88	282	562	56.0
92	0	280	-
96	0	280	-
100	0	280	-
104	0	280	-
108	0	280	-
112	0	280	-
116	0	280	-
120	280	280	40.0

Total number of peaks and troughs
in the rainflow of Helix = 4264048

Table 22

HELIX ANALYSIS OF PEAKS/TROUGHS AND OF POSITIVE LEVEL CROSSINGS

Level (Helix units)	Number peaks	Peaks cumulative	Number troughs	Troughs cumulative	Positive level crossings
-20	0	2132024	140	140	140
-16	0	2132024	0	140	140
-12	0	2132024	0	140	140
-8	0	2132024	0	140	140
-4	0	2132024	0	140	140
0	0	2132024	0	140	140
4	0	2132024	0	140	140
8	0	2132024	0	140	140
12	0	2132024	281	421	421
16	0	2132024	1688	2109	2109
20	0	2132024	2233	4342	4342
24	0	2132024	10412	14754	14754
28	0	2132024	7093	21847	21847
32	0	2132024	16898	38745	38745
36	0	2132024	1163994	1202739	1202739
40	0	2132024	676930	1879669	1879669
44	0	2132024	210951	2090620	2090620
48	0	2132024	5651	2096271	2096271
52	0	2132024	32039	2128310	2128310
56	141	2132024	88	2128398	2128257
60	160	2131883	1010	2129408	2129107
64	1834	2131723	2283	2131691	2129556
68	2798	2129889	333	2132024	2127091
72	7012	2127091	0	2132024	2120079
76	6346	2120079	0	2132024	2113733
80	248246	2113733	0	2132024	1865487
84	253998	1865487	0	2132024	1611489
88	382222	1611489	0	2132024	1229267
92	1150931	1229267	0	2132024	78336
96	73302	78336	0	2132024	5034
100	5034	5034	0	2132024	0

Value refers to interval between the defined level and the one below it

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Table 23

FELIX RAINFLOW ANALYSIS

Distribution of the ranges

Range size (Felix units)	Number of ranges	Cumulative number	Average mean (Felix units)
4	1374	4570144	41.9
8	832	4568770	43.4
12	3682	4567938	50.0
16	2072	4564256	51.9
20	3376	4562184	50.8
24	2462	4558808	49.1
28	1681	4556346	35.3
32	4055804	4554665	47.6
36	1795	498861	39.2
40	10516	497066	49.4
44	960	486550	39.1
48	342776	485590	45.9
52	3184	142814	50.2
56	105036	139630	36.9
60	3930	34594	48.7
64	20528	30664	38.7
68	2158	10136	50.3
72	6756	7978	38.9
76	234	1222	41.9
80	312	988	40.2
84	68	676	41.4
88	50	608	40.0
92	180	558	45.0
96	18	378	40.0
100	16	360	42.0
104	16	344	40.0
108	14	328	34.0
112	13	314	29.8
116	0	301	-
120	285	301	32.9
124	0	16	-
128	16	16	36.0

Total number of peaks and troughs
in the rainflow of Felix = 4570144

Table 24

FELIX ANALYSIS OF PEAKS/TROUGHS AND OF POSITIVE LEVEL CROSSINGS

Level (Felix units)	Number peaks	Peaks cumulative	Number troughs	Troughs cumulative	Positive level crossings
-28	0	2285072	546	546	546
-24	0	2285072	0	546	546
-20	0	2285072	24	570	570
-16	0	2285072	0	570	570
-12	0	2286072	8	578	578
-8	0	2285072	24	602	602
-4	0	2285072	40	642	642
0	0	2285072	1472	2114	2114
4	0	2285072	9442	11556	11556
8	140	2285072	49938	61494	61354
12	0	2284932	55619	117113	116973
16	0	2284932	9146	126259	126119
20	0	2284932	157152	283411	283271
24	0	2284932	81595	365006	364866
28	0	2284932	43200	408206	408066
32	0	2284932	1750246	2158452	2158312
36	140	2285932	17641	2176093	2175813
40	354	2284792	14290	2190383	2189749
44	470	2284438	77633	2268016	2266912
48	3196	2283968	17056	2285072	2280772
52	141552	2280772	0	2285072	2139220
56	8836	2139220	0	2285072	2130384
60	99165	2130384	0	2285072	2031219
64	1796322	2031219	0	2285072	234897
68	22370	234897	0	2285072	212527
72	83615	212527	0	2285072	128912
76	80940	128912	0	2285072	47972
80	17408	47972	0	2285072	30564
84	15500	30564	0	2285072	15064
88	13960	15064	0	2285072	1104
92	1080	1104	0	2285072	24
96	0	24	0	2285072	24
100	24	24	0	2285072	0

Value refers to interval between the defined level and the one below it

085

Table 25(a)

HELIX/32 RAINFLOW ANALYSIS

(Helix with omission level 32 and below)

Range size (Helix units)	Number of ranges	Cumulative number	Average mean (Helix units)
4	5988	291724	65.5
8	1312	285736	62.3
12	554	284424	66.0
16	138	283870	64.0
20	0	283732	-
24	0	283732	-
28	280	283732	58.0
32	0	283452	-
36	138	283452	70.0
40	15270	283314	65.2
44	0	268044	-
48	40882	268044	60.1
52	732	227162	62.8
56	190524	226430	64.0
60	142	35906	58.0
64	20130	35764	61.8
68	542	15634	57.2
72	11796	15092	57.7
76	830	3296	58.4
80	1884	2466	58.5
84	20	582	58.0
88	282	562	56.0
92	0	280	-
96	0	280	-
100	0	280	-
104	0	280	-
108	0	280	-
112	0	280	-
116	0	280	-
120	280	280	40.0
124	0	0	-
128	0	0	-
132	0	0	-

Total number of peaks and troughs in the rainflow matrix of Helix/32 = 291724

Table 25(b)

PEAK/TROUGH COUNTING HELIX/32

Survey of generated peaks and troughs

Level	Number of peaks	Number of troughs
-28	0	0
-24	0	0
-20	0	141
-16	0	0
-12	0	0
-8	0	0
-4	0	0
0	0	0
4	0	0
8	0	0
12	0	281
16	0	1688
20	0	2233
24	0	6223
28	0	4263
32	0	3102
36	0	115783
40	0	1630
44	0	609
48	0	3518
52	0	2678
56	141	88
60	160	1010
64	1026	2283
68	2798	333
72	819	0
76	886	0
80	96	0
84	20952	0
88	9452	0
92	98693	0
96	5805	0
10C	5034	0

(This is generated in computer program as a tool for checking purposes)

Table 26(a)

FELIX/28 RAINFLOW ANALYSIS

(Felix with omission level 28 and below)

Range size (Felix units)	Number of ranges	Cumulative number	Average mean (Felix units)
4	1374	322068	41.9
8	832	320694	43.4
12	3682	319862	50.0
16	1628	316180	56.0
20	4	314552	50.0
24	436	314548	32.6
28	459	314112	16.0
32	4118	313653	48.0
36	4381	309535	52.2
40	1664	305154	44.0
44	692	303490	38.0
48	162666	302798	47.3
52	872	140132	37.3
56	104666	139260	36.9
60	3930	34594	48.7
64	20528	30664	38.7
68	2158	10136	50.3
72	6756	7978	38.9
76	234	1222	41.9
80	312	988	40.2
84	68	676	41.4
88	50	608	40.0
92	180	558	45.0
96	18	378	40.0
100	16	360	42.0
104	16	344	40.0
108	14	328	34.0
112	13	314	29.8
116	0	301	-
120	285	301	32.9
124	0	16	-
128	16	16	36.0
132	0	0	-

Total number of peaks and troughs in the rainflow matrix of Felix/28 = 322068

Table 26(b)

PEAK/TROUGH COUNTING FELIX/28

Survey of generated peaks and troughs

Level	Number of peaks	Number of troughs
-28	0	547
-24	0	0
-20	0	24
-16	0	0
-12	0	8
-8	0	24
-4	0	40
0	0	1472
4	0	9442
8	140	46402
12	0	11835
16	0	6402
20	0	0
24	0	73999
28	0	0
32	0	2059
36	140	6046
40	354	354
44	470	333
48	1292	2048
52	0	0
56	0	0
60	12181	0
64	47295	0
68	6770	0
72	81319	0
76	3640	0
80	2400	0
84	3905	0
88	24	0
92	1080	0
96	0	0
100	24	0

Table 27

DATA TABLES TO BE USED FOR GENERATION OF THE FOUR SEQUENCES

Position	Helix	Helix/32	Felix	Felix/28
1	Table 28	Table 28	Table 28	Table 28
2	" 29	" 29	" 33	" 33
3	" 30	" 30	" 34	" 34
4	" 31	" 32	" 35	" 36

NOTE : position number refers to input parameters as follows:

Position 1 : sequence type; total number of sorties; sequence of sorties.

Position 2 : maximum number of manoeuvres in each sortie; position of landing and SAR markers; manoeuvre types and number of applications for all sorties.

Position 3 : number of manoeuvres in combined manoeuvre; manoeuvre types and number of applications for combined manoeuvre.

Position 4 : number of data points in each manoeuvre; sequence of data points for all manoeuvres; ground load.

Table 28

DATA ON SEQUENCE OF SORTIES - HELIX, HELIX/32, FELIX, FELIX/28

Variable name	:	ISPEC
Position of data (Table 27)	:	1
Variable type	:	Character
Description	:	Defines name of sequence generated and must be changed for each sequence !!!

'HELIX'

Variable name	:	NS
Position of data (Table 27)	:	1
Description	:	Number of values in ISEQ

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Variable name	:	ISEQ(1,140)
Position of data (Table 27)	:	1
Related Table	:	1

21	11	43	11	21	12	22	11	11	21	21	21	23	42	23	21	12	11	21	22
11	42	22	21	32	21	11	22	32	22	11	31	21	22	11	11	42	42	21	21
33	12	31	22	22	11	11	11	11	11	21	21	11	41	11	12	22	22	22	11
21	11	21	11	21	21	21	21	11	11	22	21	21	21	11	21	11	12	12	21
11	11	22	11	41	21	11	11	11	23	11	21	11	21	11	21	11	22	32	23
11	12	22	22	23	12	21	11	22	11	11	41	33	22	32	21	11	21	21	22
21	21	12	21	11	21	21	13	11	11	12	11	11	11	41	11	22	11	41	12

Variable name	:	I (Temporary)
Position of data (Table 27)	:	1
Description	:	Marks the end of position 1 data and serves as a data check

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Note: ISPEC changes as follows

SEQUENCE	ISPEC
Helix	'HELIX'
Helix/32	'HELIX/32'
Felix	'FELIX'
Felix/28	'FELIX/28'

Table 29

DATA ON SEQUENCE OF MANOEUVRES - HELIX AND HELIX/32

Position of data : 2
Related Tables : 7-10

Varible name : NMS(1,4)
Description : Number of manoeuvres in each full length sortie

206 118 257 87

Variable name : NEWN(1,5)
Description : Positions of landing and SAR markers

198 103 242 38 77

Variable name : MTYPE(1,NMS(1,4)),NOMA(1,NMS(1,4))
Description : First two numbers are the first manoeuvre in the Training sortie (Table 7), and its number of matrix applications. The next two numbers give the same information for the second manoeuvre, and so on. Data for the other three sorties follows. 0.75 h markers are -1. 2.25 h markers are -2. combined manoeuvres are 25.

1	6	2	3	3	2	4	3	3	3	2	5	9	3	10	0	19	1	10	0
15	4	16	2	13	4	14	2	20	1	10	0	2	3	3	2	4	3	5	8
7	7	6	42	11	2	12	2	6	23	11	2	6	70	12	2	6	52	12	2
6	35	11	2	6	63	12	2	6	21	11	2	6	5	12	2	6	83	11	2
6	8	-1	0	12	2	6	39	23	5	5	8	4	6	3	4	2	6	9	3
10	0	2	3	3	2	4	9	3	4	2	3	9	3	10	0	2	3	3	2
4	10	3	4	2	3	9	3	10	0	19	1	2	3	3	2	4	3	5	10
7	6	6	7	12	2	6	13	12	2	6	43	11	2	23	5	5	10	4	4
3	3	2	3	9	3	10	0	2	9	9	3	10	0	20	1	17	4	18	1
2	3	3	2	4	3	5	12	7	6	6	7	12	2	6	9	12	2	6	15
11	2	6	45	12	2	6	3	11	2	6	95	11	2	6	67	12	2	6	19
11	2	6	3	11	2	6	106	12	2	6	53	12	2	6	23	11	2	6	17
11	2	6	63	12	2	6	10	-2	0	12	2	6	83	11	2	6	5	11	2
6	3	11	2	6	4	12	2	6	7	11	2	6	3	12	2	6	9	12	2
6	3	11	2	6	98	21	12	22	1	5	41	4	6	3	4	2	3	8	2
10	0	2	22	9	3	10	0	13	2	14	2	17	6	18	2	19	1	20	1
10	0	15	4	16	1	19	1	17	6	18	2	10	0	2	3	3	2	4	3
5	12	7	4	6	4	12	2	6	3	11	2	6	5	11	2	6	59	11	2
6	93	12	2	6	31	11	2	6	76	11	2	6	3	12	2	6	2	12	2
6	11	11	2	6	36	12	2	6	61	11	2	6	64	23	4	5	6	4	4
3	2	2	4	9	3	10	0	19	1	24	3								
1	6	2	3	3	2	4	3	5	39	7	20	6	196	12	1	6	34	12	1
6	26	-1	0	11	1	6	99	11	1	6	116	12	1	6	132	11	1	6	33
12	1	6	59	12	1	6	22	12	1	6	52	11	1	6	12	12	1	6	64
12	1	6	12	11	1	6	74	11	1	6	78	11	1	6	15	11	1	6	10
11	1	6	141	12	1	6	31	11	1	6	35	12	1	6	75	-2	0	12	1
6	72	11	1	6	49	12	1	6	78	12	1	6	76	12	1	6	61	12	1

Table 29 (concluded)

6	39	12	1	6	52	11	1	6	50	11	1	6	21	12	1	6	35	12	1
6	5	11	1	6	43	12	1	6	32	11	1	6	74	12	1	6	85	11	1
6	5	11	1	6	72	12	1	6	25	11	1	6	22	12	1	6	20	21	12
22	1	23	4	5	38	4	3	3	2	2	3	8	3	10	0	2	3	3	2
4	3	5	29	23	3	5	183	4	5	3	3	2	4	8	2	10	0	13	8
14	2	19	1	17	12	18	2	15	9	16	2	20	1	24	6				
1	2	2	3	3	2	4	3	5	6	7	4	6	10	12	2	6	2	11	2
6	7	11	2	6	8	12	2	6	12	11	2	6	8	12	2	6	13	12	2
6	4	11	2	6	8	12	2	6	9	12	2	6	8	12	2	6	7	25	1
25	1	25	1	6	13	12	2	6	14	12	2	-1	0	25	1	6	2	11	2
6	12	12	2	6	13	12	2	6	9	12	2	6	9	11	2	6	8	11	2
25	1	6	9	11	2	6	4	11	2	6	6	11	2	6	5	12	2	25	1
6	11	11	2	6	8	12	2	6	5	12	2	6	11	12	2	25	1	6	9
11	2	6	7	11	2	6	7	11	2	6	14	11	2	6	13	12	2	25	1
6	7	11	2	6	7	11	2	6	9	12	2	6	6	12	2	6	6	11	2
6	10	12	2	6	3	11	2	6	12	11	2	25	1	6	2	11	2	6	2
12	2	6	15	11	2	6	7	12	2	6	6	12	2	6	1	12	2	6	9
12	2	6	5	11	2	6	4	11	2	6	8	12	2	6	2	11	2	6	2
12	2	-2	0	25	1	6	14	11	2	6	6	12	2	6	10	12	2	6	5
11	2	25	1	6	8	12	2	6	9	11	2	6	6	12	2	6	7	11	2
6	16	12	2	6	15	11	2	6	6	11	2	25	1	6	5	11	2	6	7
11	2	6	13	12	2	6	9	12	2	6	6	11	2	25	1	6	11	12	2
6	3	12	2	6	4	11	2	6	1	11	2	6	5	12	2	6	5	11	2
6	7	11	2	6	10	12	2	6	8	11	2	25	1	6	1	11	1	6	5
12	2	6	16	11	2	6	12	11	2	6	3	12	2	6	10	11	2	6	8
12	2	6	10	11	2	6	6	11	2	6	22	11	2	6	6	11	2	6	4
11	2	6	8	11	2	6	4	12	2	6	6	11	2	6	7	11	2	6	3
12	2	6	7	11	2	6	8	11	2	6	12	12	2	6	6	12	2	6	6
11	2	6	11	12	2	6	20	11	2	6	4	11	2	6	15	12	2	6	5
11	2	6	11	11	2	6	13	11	2	6	4	11	2	6	12	11	2	21	12
22	1	23	8	5	27	4	7	3	5	2	7	9	5	10	0	13	8	14	2
19	1	17	12	18	2	15	9	16	2	20	1	24	3						
1	6	2	2	3	1	4	2	5	8	7	10	6	63	11	1	6	39	-1	0
12	1	6	110	11	1	6	64	12	1	6	31	12	1	6	23	12	1	6	51
12	1	6	60	11	1	6	75	12	1	6	121	12	1	6	52	11	1	-2	0
6	62	12	1	6	128	12	1	6	50	23	4	5	500	23	4	5	145	4	2
3	1	2	2	9	2	10	0	13	8	14	2	17	12	18	2	20	1	2	2
3	1	4	2	5	16	7	10	11	1	6	78	-1	0	11	1	6	136	11	1
6	46	12	1	6	71	12	1	6	166	12	1	6	58	-2	0	11	1	6	105
11	1	6	83	11	1	6	81	23	3	5	198	23	4	5	8	4	2	3	2
2	2	9	1	10	0	15	9	16	2	19	1	24	3						

Variable name : I (Temporary)
Description : Marks the end of position 1 data and serves as a data check.

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Table 30

DATA ON SEQUENCE OF MANOEUVRES IN THE ASW COMBINED MANOEUVRE - HELIX AND HELIX/32

Position of data (Table 27) : 3
Related Table : 11

Variable name : KASW
Description : Number of manoeuvres in the ASW Combined Manoeuvre

16

Variable names : IASWTY(1,NASW),MASW(1,NASW)
Description : Manoeuvre number and number of applications

23	5	4	3	2	9	10	2	3	4	5	7	6	12	6	12
2	6	3	2	3	3	0	3	2	3	6	4	4	2	3	2

Variable name : I (Temporary)
Description : Marks the end of position 1 data and serves as a data check.

939

Table 31

DATA ON CONTENT OF MANOEUVRES - HELIX

Position of data : 4
Related Table : 5
Data particular to Helix

Variable name : NLM(1,24)
Description : Number of data points describing each manoeuvre

3	14	15	15	14	19	2	36	27	0	23	19
4	29	10	24	2	25	41	4	20	18	14	6

Variable name : LSM(NLM(1,24))
Description : Sequence of loads in each manoeuvre

44	20	20																	
72	20	20	20	20	20	20	20	20	20	20	20	20	20						
68	24	24	24	28	28	24	24	24	24	24	24	24	24	24					
60	24	24	24	20	20	20	24	24	28	20	24	24	24	24					
60	20	24	20	20	20	20	20	20	20	24	20	20	20						
64	28	28	28	28	28	24	20	28	28	28	28	24	28	24	24	28	20	28	
68	20																		
56	32	20	32	36	20	20	28	20	36	20	20	32	20	32	20	36	28	24	20
32	20	36	20	32	32	28	28	24	28	20	28	24	24	32	24				
60	20	28	20	20	28	36	20	28	36	28	20	24	20	36	36	40	24	20	32
32	32	20	20	36	20	20													
68	28	28	28	28	28	28	28	28	28	32	28	28	28	28	28	28	28	28	28
28	28	24																	
68	24	32	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	
56	20	20	20																
52	20	28	28	36	24	20	24	28	20	32	20	20	36	20	20	24	28	28	20
28	28	20	24	20	24	28	28	20											
60	24	20	20	24	24	28	28	28	20										
52	36	20	36	32	20	28	40	36	36	20	20	24	20	24	20	20	28	20	28
20	20	32	20																
68	20																		
60	32	28	32	28	28	28	32	28	28	36	20	20	32	32	20	28	32	28	32
32	32	20	32	28															
64	20	20	20	20	20	28	20	24	20	20	28	20	24	24	20	20	20	20	20
20	20	20	24	20	20	24	20	20	24	20	20	24	20	20	20	20	20	20	24
20																			
68	20	20	20																
60	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
60	28	28	24	28	24	32	36	28	28	28	32	28	28	32	32	28	28		
60	24	20	20	20	20	20	20	20	20	20	20	20	24						
72	28	24	24	24	20														

Table 31 (concluded)

Variable name : LOADG
Description : Ground load value

-20

Variable name : I (Temporary)
Description : Marks the end of position 4 data and serves as a data check.

949

Table 32

DATA ON CONTENT OF MANOEUVRES - HELIX/32

Position of data (Table 27) : 4
Related table : 18
Data particular to Helix/32

Variable name : NLM(1,24)
Description : Number of data points in each manoeuvre

2	2	2	2	2	2	2	13	10	0	2	2
2	4	2	8	2	12	2	2	2	6	2	2

Variable name : LSM(NLM(1,24))
Description : Sequence of loads in each manoeuvre

44	20											
72	20											
68	28											
60	28											
60	24											
64	28											
68	20											
56	32	32	36	36	32	32	36	32	36	32	32	32
60	36	36	36	36	40	32	32	32	36			
68	32											
68	32											
56	20											
52	36	32	36									
60	28											
52	36	36	32	40	36	36	32					
68	20											
60	32	32	32	36	32	32	32	32	32	32	32	
64	28											
68	20											
60	20											
60	32	36	32	32	32							
60	24											
72	28											

Variable name : LOADG
Description : Ground load value

-20

Variable name : I (Temporary)
Description : Marks the end of position 4 data and serves as a data check

949

Table 33

DATA ON SEQUENCE OF MANOEUVRES - FELIX AND FELIX/28

Position of data (Table 27) : 2
Related Tables : 12-15

Variable name : NMS(1,4)
Description : Number of manoeuvres in each full length sortie

222 125 360 92

Variable name : NEWN(1,5)
Description : Position of landing and SAR markers

214 111 348 40 81

Variable names : MTYPE(1,NMS(1,4)),NOMA(1,NMS(1,4))
Description : First two numbers are the first manoeuvre in the Training sortie (Table 12), and its number of matrix applications. The next two numbers give the same information for the second manoeuvre, and so on. Data for the other three sorties follows. 0.75 h markers are -1. 2.25 h markers are -2. Combined manoeuvres are 25.

1	2	2	3	3	0	19	1	4	3	20	1	3	0	19	2	20	2	2	4
8	1	9	6	15	1	9	5	13	4	12	4	15	1	9	3	2	3	3	0
19	2	4	3	20	2	5	0	7	0	6	30	10	4	11	1	6	16	10	4
6	54	11	1	6	38	11	2	6	26	10	6	6	51	11	1	6	17	10	5
6	5	11	1	6	68	10	4	6	7	-1	0	11	1	6	31	21	6	5	0
20	1	4	5	3	0	19	1	2	5	8	2	9	6	2	3	3	0	19	1
4	8	20	1	3	0	2	3	8	2	9	5	2	3	3	0	19	2	4	8
20	2	3	0	2	3	8	1	9	46	15	2	2	3	3	0	19	1	4	3
20	1	5	0	7	0	6	5	11	1	6	9	11	1	6	31	10	5	21	6
5	0	20	1	4	4	3	0	19	1	2	3	8	1	9	17	2	9	8	1
9	55	15	1	14	5	2	3	3	0	19	2	4	4	20	2	5	0	7	0
6	6	11	1	6	7	11	1	6	12	10	4	6	37	11	1	6	2	10	4
6	77	10	5	6	54	11	1	6	16	10	4	6	3	10	4	6	85	11	1
6	42	11	1	6	18	10	4	6	13	10	4	6	51	11	1	6	8	-2	0
11	1	6	67	10	4	6	4	10	3	6	2	10	4	6	3	11	1	6	6
10	4	6	2	11	1	6	8	11	1	6	2	10	4	6	79	16	2	17	1
16	2	18	1	5	0	20	2	4	6	3	0	19	2	2	3	8	1	9	13
2	21	8	1	9	61	12	3	14	9	15	2	9	34	13	3	15	1	14	9
9	24	2	3	3	0	19	2	4	3	20	2	5	0	7	0	6	6	11	1
6	2	10	4	6	4	10	4	6	48	10	4	6	75	11	2	6	25	10	4
6	62	10	4	6	2	11	1	6	2	11	1	6	9	10	4	6	30	11	1
6	51	10	4	6	53	21	5	5	0	4	5	3	0	2	4	8	1	9	2
15	1	22	1																
1	2	2	3	3	0	19	4	4	2	20	4	5	0	7	0	6	147	10	1
6	25	11	1	6	19	-1	0	10	4	6	82	10	4	6	96	11	1	6	109

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Table 33 (continued)

10	4	6	27	11	1	6	48	11	1	6	17	11	1	6	42	10	4	6	10
11	1	6	52	11	1	6	10	10	1	6	62	10	1	6	65	10	1	6	13
10	1	6	8	10	1	6	119	10	1	6	27	10	1	6	29	10	1	6	64
-2	0	10	1	6	57	10	1	6	38	10	1	6	61	10	1	6	60	10	1
6	48	10	1	6	30	10	1	6	41	10	1	6	39	10	1	6	16	10	1
6	26	10	1	6	6	10	1	6	32	11	1	6	26	10	1	6	56	10	1
6	64	10	1	6	4	10	1	6	56	11	1	6	19	10	1	6	17	11	1
6	15	16	2	17	1	16	2	18	1	21	6	5	0	20	5	4	3	3	0
19	5	2	3	8	1	9	31	2	3	3	0	19	4	4	3	20	4	5	0
21	3	5	0	20	4	4	5	3	0	19	4	2	4	8	1	9	10	12	7
15	2	14	14	13	7	15	2	22	2										
1	1	2	3	3	0	19	1	4	3	20	1	5	0	7	0	6	8	11	2
6	2	10	4	6	6	10	4	6	6	11	2	6	10	10	3	6	6	11	2
6	10	11	3	6	3	10	4	6	6	11	2	6	7	11	2	6	6	11	2
6	6	21	3	5	0	4	2	3	0	2	3	8	1	9	25	25	1	21	3
5	0	4	2	3	0	2	3	8	1	9	17	25	1	21	2	5	0	4	3
3	0	2	2	8	1	9	10	25	1	6	11	11	3	6	11	10	3	-1	0
21	2	5	0	4	3	3	0	2	3	8	2	9	32	25	1	6	2	10	4
6	9	10	2	6	10	11	2	6	7	10	3	6	7	10	3	6	6	10	3
21	2	5	0	4	3	3	0	2	2	8	2	9	51	25	1	6	6	10	3
6	3	10	4	6	5	10	3	6	4	11	3	21	2	5	0	4	3	3	0
2	3	8	2	9	41	25	1	6	9	10	3	6	6	11	2	6	4	11	3
6	8	10	3	21	3	5	0	4	2	3	0	2	3	8	2	9	36	25	1
6	7	10	3	6	6	10	3	6	6	10	3	6	10	10	3	6	10	10	3
21	2	5	0	20	1	4	3	3	0	19	1	2	3	8	1	9	44	25	1
6	6	10	3	6	5	10	3	6	7	10	2	6	5	11	3	6	5	10	3
6	7	11	3	6	2	10	3	6	9	10	3	21	2	5	0	4	3	3	0
2	3	8	1	9	42	25	1	6	2	10	3	6	2	11	2	6	13	10	3
6	6	11	2	6	6	10	2	6	1	11	2	6	8	10	3	6	4	10	3
6	3	10	3	6	6	10	3	6	2	10	3	6	2	10	2	-2	0	21	3
5	0	4	2	3	0	2	2	8	1	9	21	25	1	6	10	10	3	6	5
11	2	6	8	10	3	6	4	10	3	21	3	5	0	4	3	3	0	2	2
8	1	9	32	25	1	6	6	10	3	6	7	10	3	6	5	10	2	6	6
10	3	6	12	10	2	6	11	10	3	6	5	10	3	21	2	5	0	4	3
3	0	2	3	8	1	9	22	25	1	6	4	10	3	6	6	10	3	6	9
11	2	6	7	10	2	6	5	10	3	21	2	5	0	20	1	4	3	3	0
19	1	2	3	8	1	9	39	25	1	6	9	10	3	6	2	11	2	6	3
10	3	6	1	10	3	6	4	11	2	6	4	10	3	6	5	10	3	6	8
11	2	6	7	10	3	21	2	5	0	4	3	3	0	2	3	8	1	9	31
25	1	6	1	10	2	6	4	11	2	6	14	10	3	6	11	10	3	6	2
11	2	6	9	10	3	6	6	11	2	6	9	10	3	6	5	10	3	6	18
10	3	6	5	10	3	6	3	10	3	6	7	10	3	6	3	11	3	6	5
10	3	6	7	10	3	6	3	11	2	6	7	10	3	6	7	10	3	6	10
11	2	6	5	11	2	6	5	10	3	6	10	11	3	6	17	10	3	6	3
10	3	6	12	11	3	6	4	10	3	6	9	10	3	6	11	10	3	6	3
10	3	6	10	10	3	16	2	17	1	16	2	18	1	21	10	5	0	4	7
3	0	2	7	8	2	9	30	12	7	15	2	14	14	13	7	15	2	22	1
1	2	2	2	3	0	19	4	4	2	20	4	5	0	7	0	6	32	10	1
6	18	-1	0	10	1	6	92	10	2	6	53	10	1	6	26	10	1	6	19
11	1	6	43	11	1	6	50	10	2	6	63	10	1	6	101	11	1	6	43
10	1	-2	0	6	52	11	1	6	107	11	1	6	39	21	4	5	0	21	5
5	0	20	4	4	2	3	0	19	4	2	2	8	1	9	65	12	7	14	14

Table 33 (concluded)

15	3	2	2	3	0	19	5	4	2	20	5	5	0	7	0	10	1	6	49
-1	0	10	2	6	113	10	2	6	38	11	1	6	59	10	2	6	138	10	2
6	48	-2	0	10	1	6	84	10	2	6	67	10	1	6	66	21	4	5	0
21	4	5	0	20	4	4	1	3	0	19	4	2	1	8	1	9	4	13	7
15	1	22	1																

Variable name : I (Temporary)
Description : Marks the end of position 1 data and serves as a data check

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Table 34

DATA ON SEQUENCE OF MANOEUVRES IN ASW COMBINED MANOEUVRE - FELIX AND FELIX/28

Position of data (Table 27) : 3
Related Table : 16

Variable name : KASW
Description : Number of manoeuvres in the combined manoeuvre

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Variable names : IASWTY(1,NASW),MASW(1,NASW)
Description : Manoeuvre number and number of applications

2	3	19	4	20	5	7	6	10	6	10
3	0	1	3	1	0	0	3	2	2	2

Variable name : I (Temporary)
Description : Marks the end of position 3 data and serves as a data check

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Table 35

DATA ON CONTENT OF MANOEUVRES - FELIX

Position of data (Table 27) : 4
Related Table : 6
Data particular to Felix

Variable name : NLM(1,24)
Description : Number of data points describing each manoeuvre

33	14	0	3	0	26	0	12	12	25	29	15
44	21	19	68	75	35	54	60	30	3	0	0

Variable name : LSM(NLM(1,24))
Description : Sequence of loads in each manoeuvre

32	16	24	28	28	24	16	16	24	24	28	16	28	24	24	24	24	24	16	24
16	28	28	24	28	28	24	28	24	32	28	28	16							
48	16	16	24	16	16	16	16	16	24	16	16	16	16						
48	16	16																	
48	16	16	16	16	16	16	16	16	16	16	24	16	16	16	16	16	16	16	16
16	16	16	16	16	16														
40	16	16	16	24	16	16	16	16	16	16	16								
36	16	16	16	16	16	16	16	24	16	16	16								
60	16	16	24	16	16	16	16	16	16	24	16	24	16	16	16	16	16	16	16
24	16	16	16	16															
64	24	16	16	16	24	24	24	24	24	16	24	16	24	16	24	24	16	16	16
16	16	24	16	28	24	16	16	24											
36	16	16	24	16	16	16	16	24	16	24	16	16	16	16					
36	16	24	16	28	24	24	24	16	16	24	24	28	24	28	24	28	28	28	24
24	24	24	16	24	24	32	28	28	24	24	28	16	28	28	24	16	24	28	28
16	16	24	16																
36	24	16	16	24	16	16	16	24	24	16	28	16	24	24	24	24	16	24	16
16																			
36	16	16	16	16	16	24	16	16	16	24	16	16	16	16	16	16	16	16	
40	16	16	16	32	16	28	24	16	16	16	24	16	24	16	32	28	16	16	16
24	28	16	24	36	16	24	16	16	28	24	24	28	44	24	28	24	16	24	16
16	24	24	24	16	24	16	28	16	16	24	28	24	16	16	24	16	16	24	24
32	28	16	16	16	16	24	16												
40	16	16	16	32	16	28	24	16	16	16	24	16	24	16	32	28	16	16	48
16	24	28	16	24	36	60	16	24	16	16	28	24	24	28	52	44	24	28	48
24	60	16	24	16	16	24	24	24	16	24	16	60	28	16	16	24	28	24	16
16	24	16	16	48	24	24	32	28	16	16	16	16	24	16					
36	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
16	24	16	16	16	16	16	24	16	16	16	16	16	16	16					
36	16	16	24	28	16	16	16	24	16	24	16	16	24	16	24	16	28	16	36
32	28	16	16	16	16	16	16	16	24	24	16	16	32	24	32	24	16	16	24
16	28	16	16	28	16	16	24	16	16	16	24	16	16						
44	16	16	16	36	16	24	16	16	16	16	16	32	24	16	16	16	24	28	16
16	24	36	24	32	16	16	16	16	28	16	24	24	28	24	16	16	24	16	24
16	28	16	16	16	16	16	16	24	16	16	28	16	32	24	24	16	16	16	16
36	28	28	28	24	28	28	28	28	32	28	28	28	28	28	28	28	28	28	28
28	28	28	32	28	28	28	28	28	28										
8	36	36																	

Table 35 (concluded)

Variable name	:	LOADG
Description	:	Ground load value

-28

Variable name	:	I (Temporary)
Description	:	Marks the end of position 4 data and serves as a data check

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Table 36

DATA ON CONTENTS OF MANOEUVRES - FELIX/28

Position of data : 4
Related Table : 19
Data particular to Felix/28

Variable name : NLM(1,24)
Description : Number of data points describing each manoeuvre

13	2	0	2	0	2	0	2	2	2	2	2
15	2	2	15	22	2	10	11	29	3	0	0

Variable name : LSM(NLM(1,24))
Description : Sequence of loads in each manoeuvre

32	28	28	28	28	28	28	28	28	28	32	28	28				
48	24															
48	16															
48	24															
40	24															
36	24															
60	24															
64	28															
36	24															
36	28	28	28	28	28	28	32	28	28	28	28	28	28	28		
36	28															
36	24															
40	32	28	32	28	28	36	28	28	44	28	28	28	32	28		
40	32	28	32	28	48	28	36	60	28	28	52	44	28	48	60	60
32	28															
36	24															
36	28	28	36	32	28	32	32	28	[illegible]							
44	36	32	28	36	32	28	28	28	28	32						
36	28	28	28	28	28	28	28	32	28	28	28	28	28	28	28	28
28	28	32	28	28	28	28	28	28								
8	36	36														

Variable name : LOADG
Description : Ground load value

-28

Variable name : I (Temporary)
Description : Marks the end of position 4 data and serves as a data check

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Table 37

DESCRIPTION OF THE VARIABLES USED IN THE HELIX AND FELIX GENERATION ALGORITHM FLOW CHARTS

Variable	Description
I	Incremental counter for sortie sequence
IASWTY	Sequence of manoeuvres in the standard ASW sonar dunk operations (Tables 30 and 34)
ISARJ	Counter to indicate search and rescue portion of SAR sortie
ISEQ	Sequence of 140 sorties that define Helix and Felix (Table 28)
ISORTE	The sortie to be simulated
K, L	Dummy variables
LSM	Sequence of loads in each manoeuvre (see Tables 31, 32, 35 and 36)
MANNO	The manoeuvre to be simulated
MASW	Number of applications of LSM required for each manoeuvre in the manoeuvre sequence IASWTY (see Tables 30 and 34)
MTYPE	Sequence of manoeuvres in each of the four sorties (see Tables 2 and 33)
N	Incremental counter for manoeuvre sequence in a sortie
NASW	Incremental counter for standard ASW sonar dunk manoeuvre sequence
NEWN	Manoeuvre sequence number in each sortie that starts the landing sequence and the manoeuvre sequence number that starts the search and rescue routine in the SAR sortie (Tables 29 and 33)
NLM	Number of loads in manoeuvre (see Tables 31, 32, 35 and 36)
NOMA	Number of applications of LSM required for each manoeuvre in the manoeuvre sequence for each sortie, MTYPE (see Tables 29 and 33)
NMS	Number of manoeuvres in each of the four sorties (see Tables 29 and 33)

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2	Various authors	FALSTAFF. A description of a Fighter Aircraft Loading STAndard For Fatigue evaluation. Joint publication by F and W (Switzerland), LBF and IABG (Germany) and NLR (Netherlands) (1976)
3	P.R. Edwards J. Darts	Standardised fatigue loading sequences for helicopter rotors (Helix and Felix). Part 1 : Background and fatigue evaluation. Joint Report of RAE, NLR, IABG and LBF RAE Technical Report 84084, NLR Technical Report 84043U Part 1, LBF FB 167 Part 1, IABG TF 1425 (1984)
4	J. Darts D. Schütz	Development of standardised fatigue test load histories for helicopter rotors - basic consideration and definition of Helix and Felix. In : Helicopter fatigue life assessment, AGARD CP-297 (1980)
5	D. Schütz H.G. Köbler W. Schütz M. Hück	Development of standardised fatigue test load histories for helicopter rotors - fatigue test programme and test results. In : Helicopter fatigue life assessment, AGARD CP-297 (1980)
6	H. Lowak J.B. de Jonge J. Franz D. Schütz	MINITWIST - a shortened version of TWIST. NLR MP 79018 U (1979) LBF Report TB-146 (1979)

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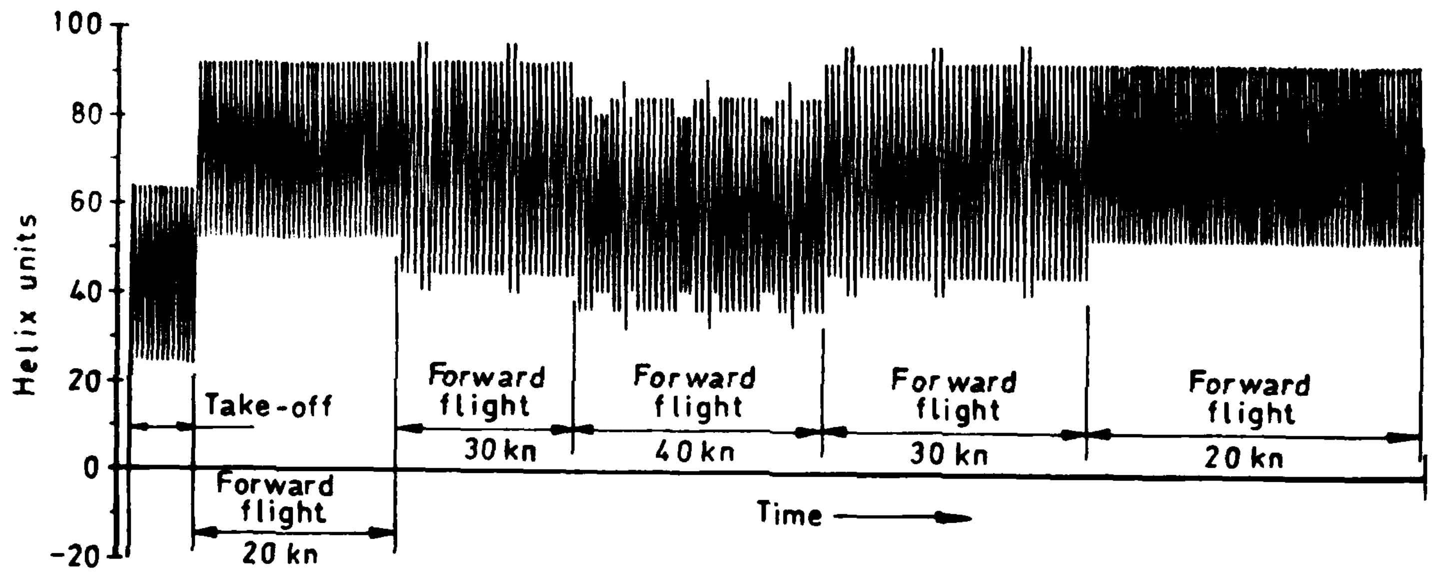
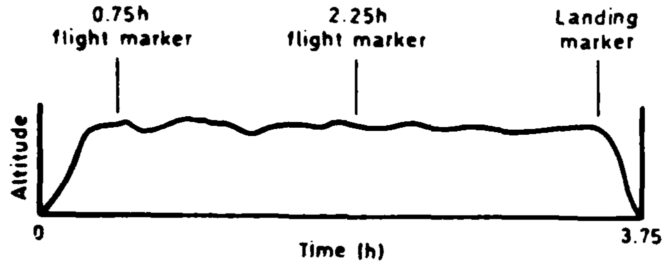
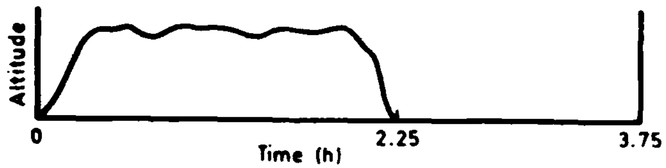


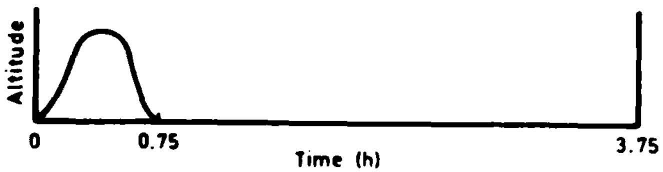
Fig 1 Example of the load time history for the first phase of a training flight in Helix



a Altitude profile for 3.75h flight

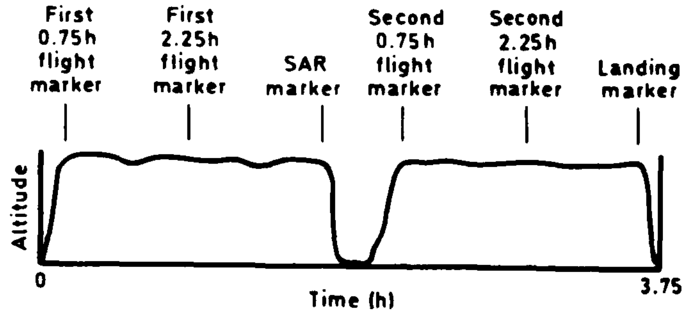


b Altitude profile for 2.25h flight

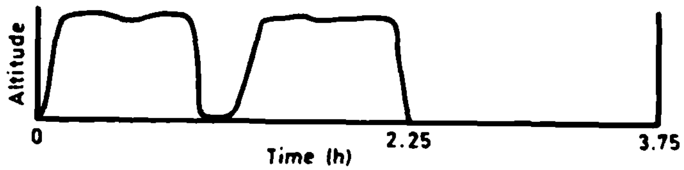


c Altitude profile for 0 75h flight

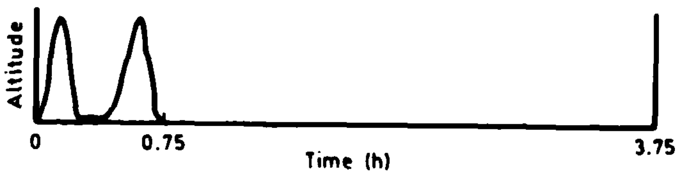
Fig 2a-c Example of the construction of the 0.75 h and 2.25 h transport training and ASW flights



a Altitude profile for 3.75h SAR flight



b Altitude profile for 2.25h SAR flight



c Altitude profile for 0.75h SAR flight

Fig 3a-c Example of the construction of the 0.75 h and 2.25 h SAR flights

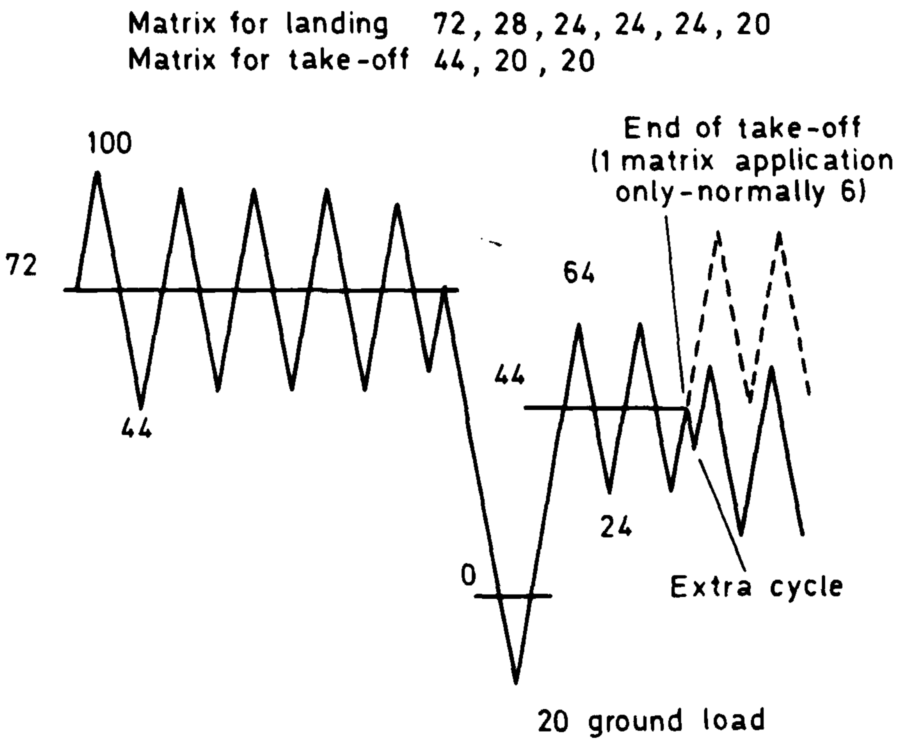


Fig 4 Landing/take-off sequence with alternative following loads

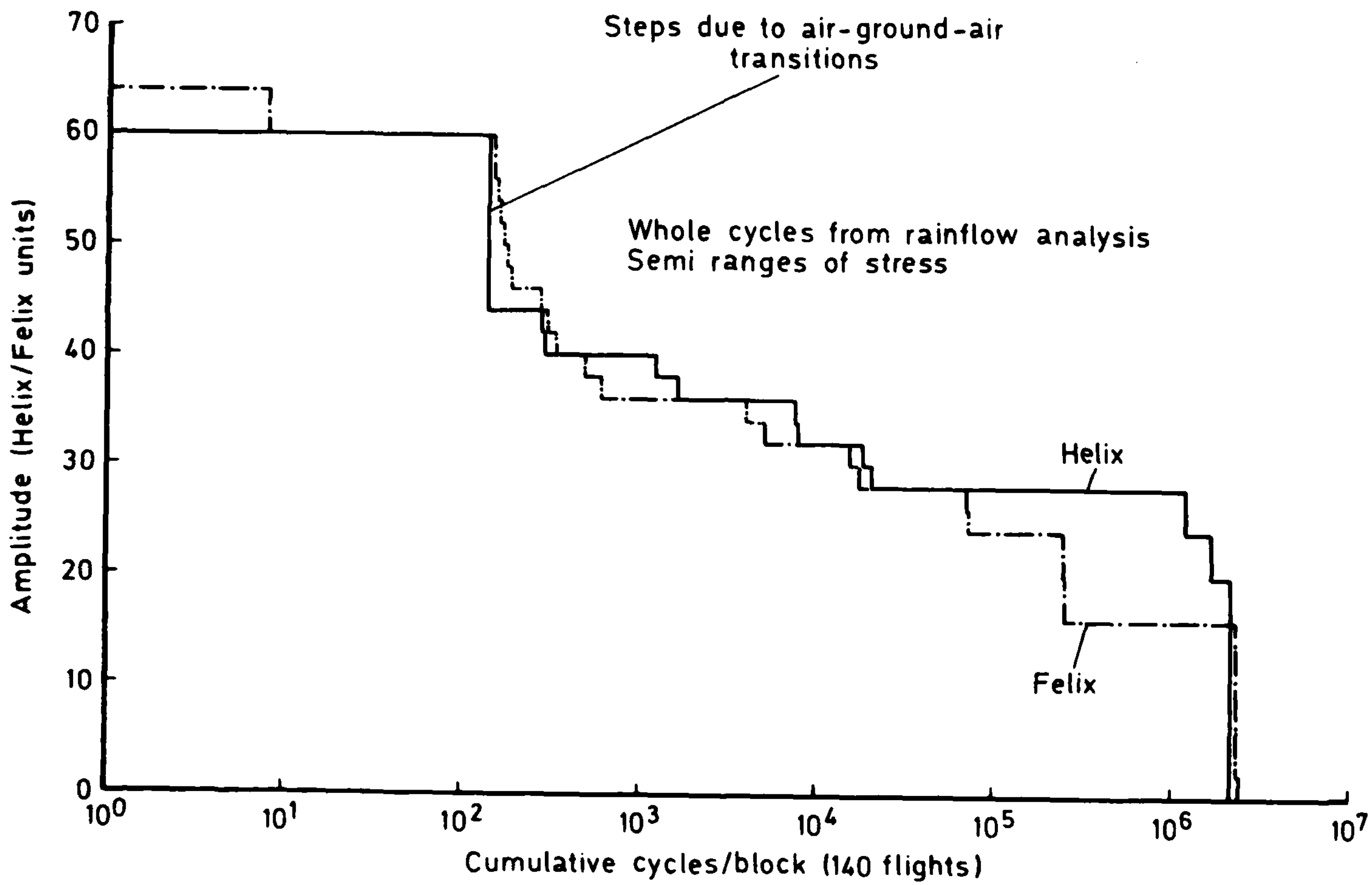


Fig 5 Comparison of Helix and Felix — whole cycles from rainflow analysis

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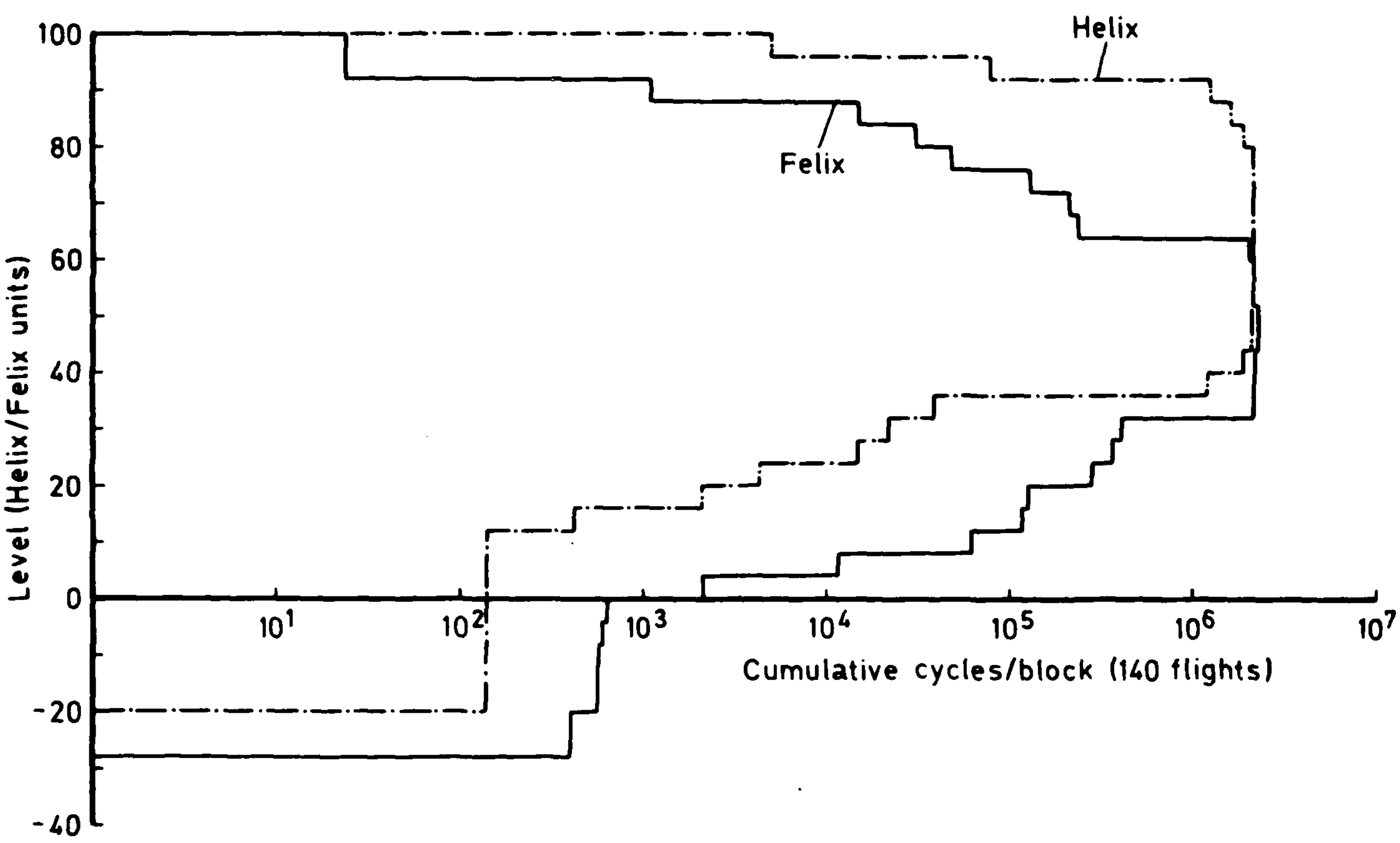

Fig 6 Comparison of Helix and Felix spectra — positive — going levels crossed

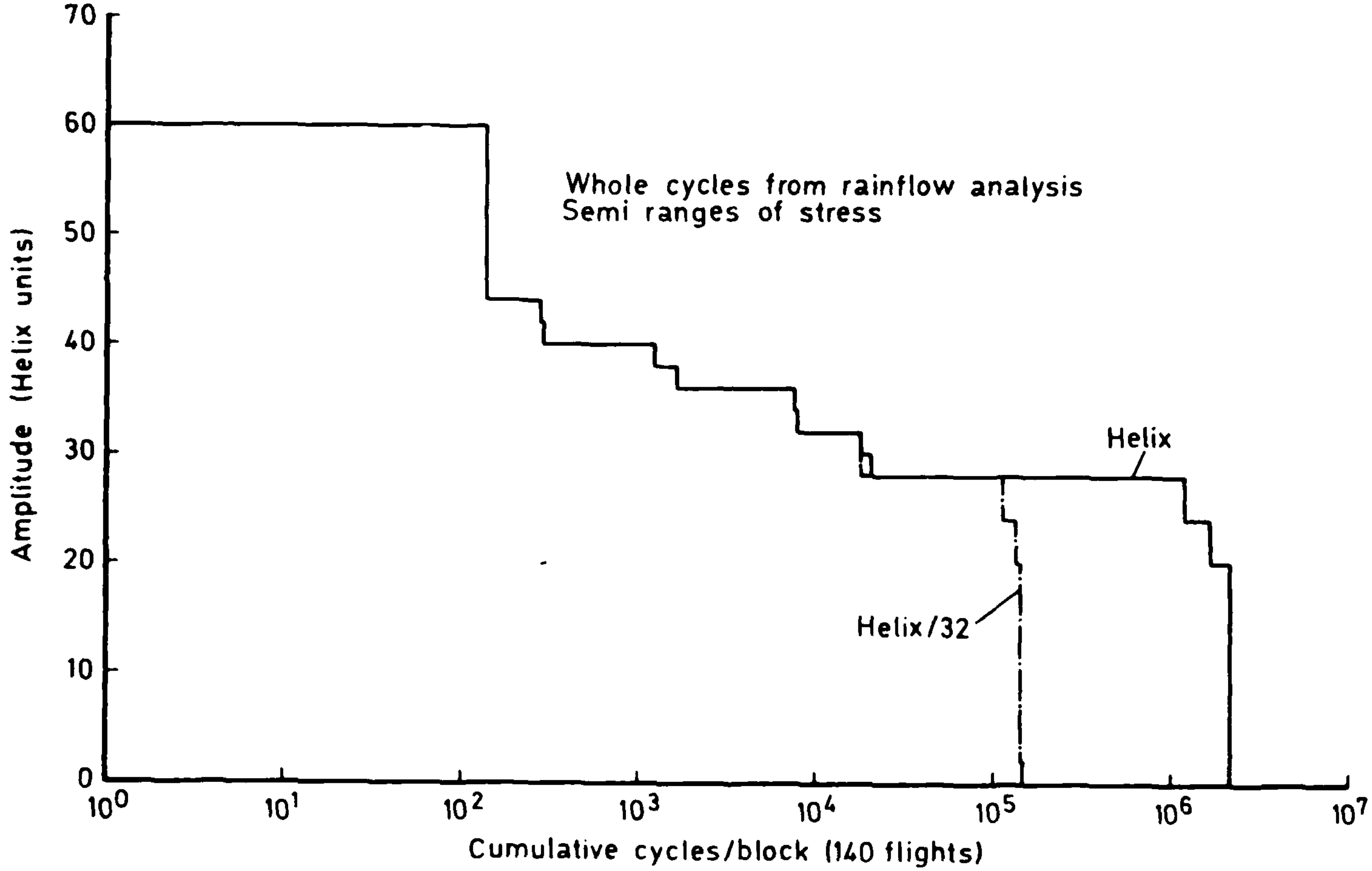

Fig 7 Comparison of spectra of Helix and Helix with omission level 32

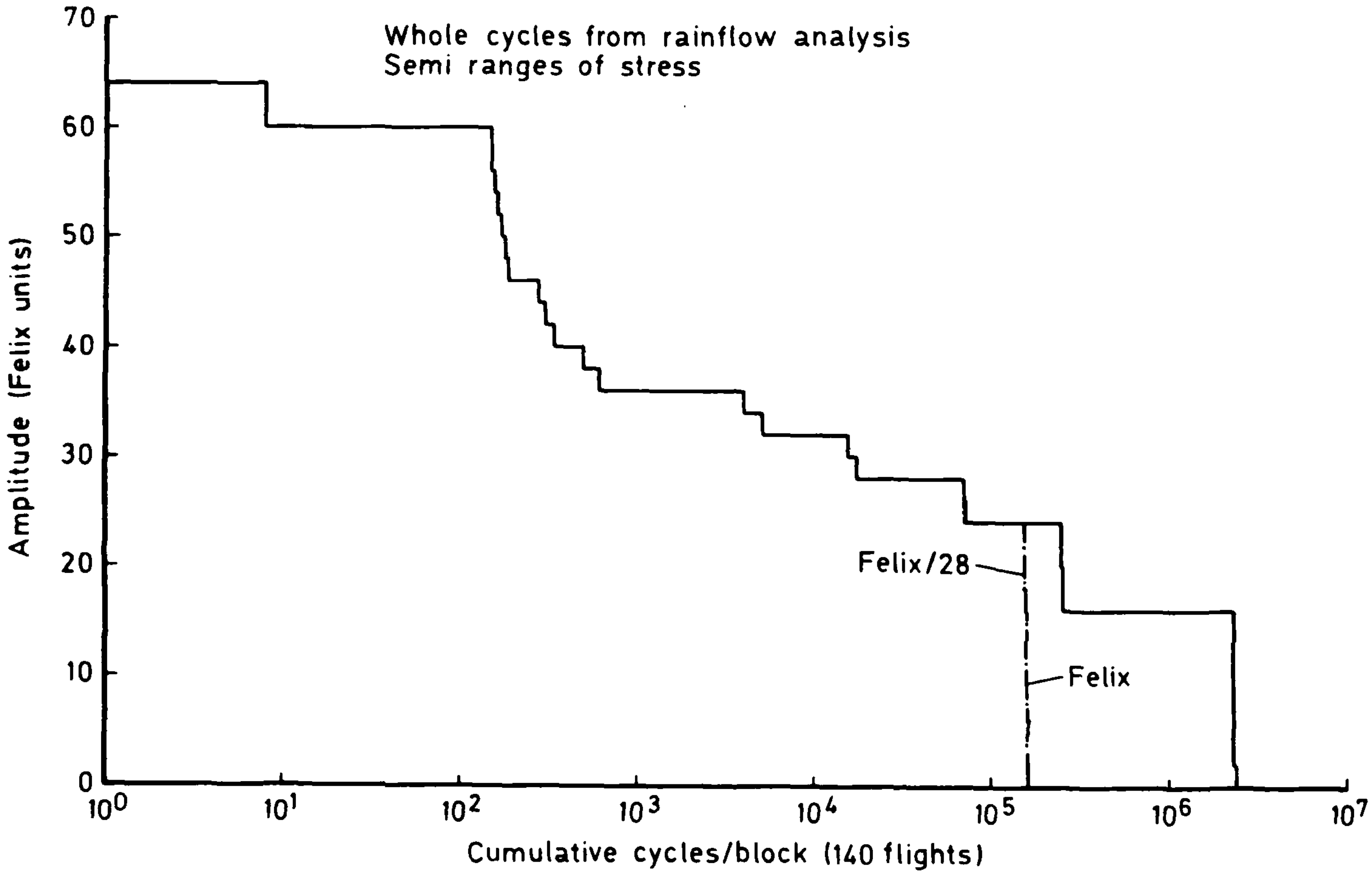

Fig 8 Comparison of spectra for Felix and Felix with omission level 28

Fig 9

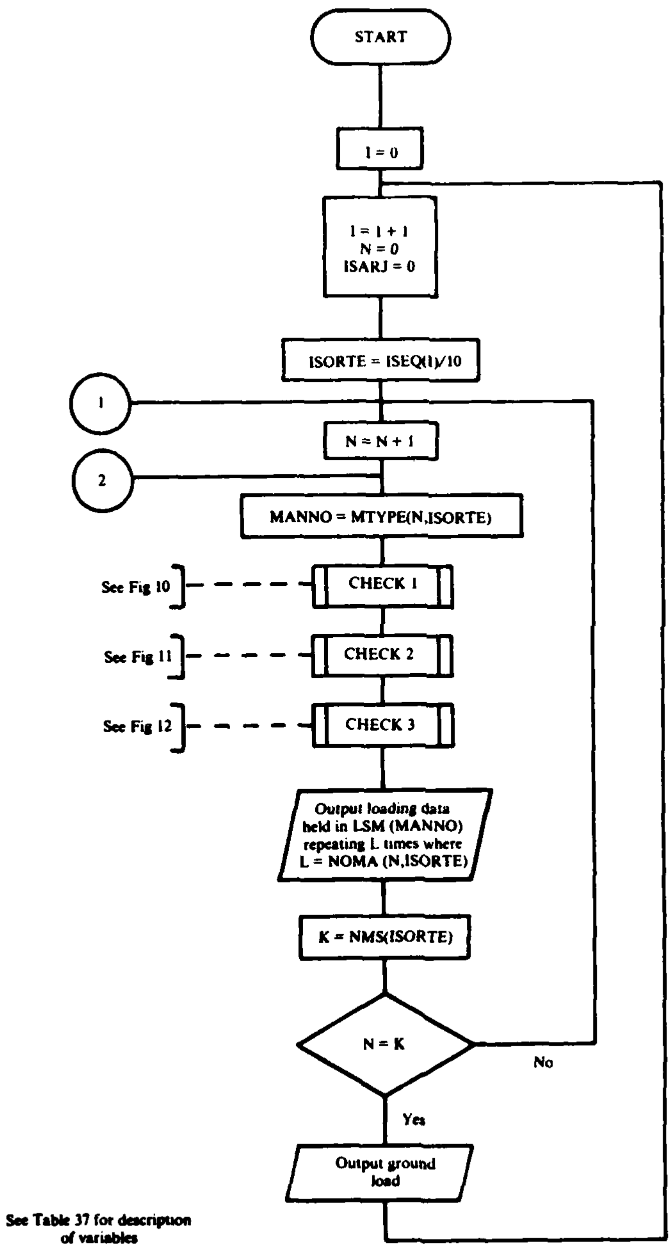

Fig 9 Generation algorithm for Helix and Felix

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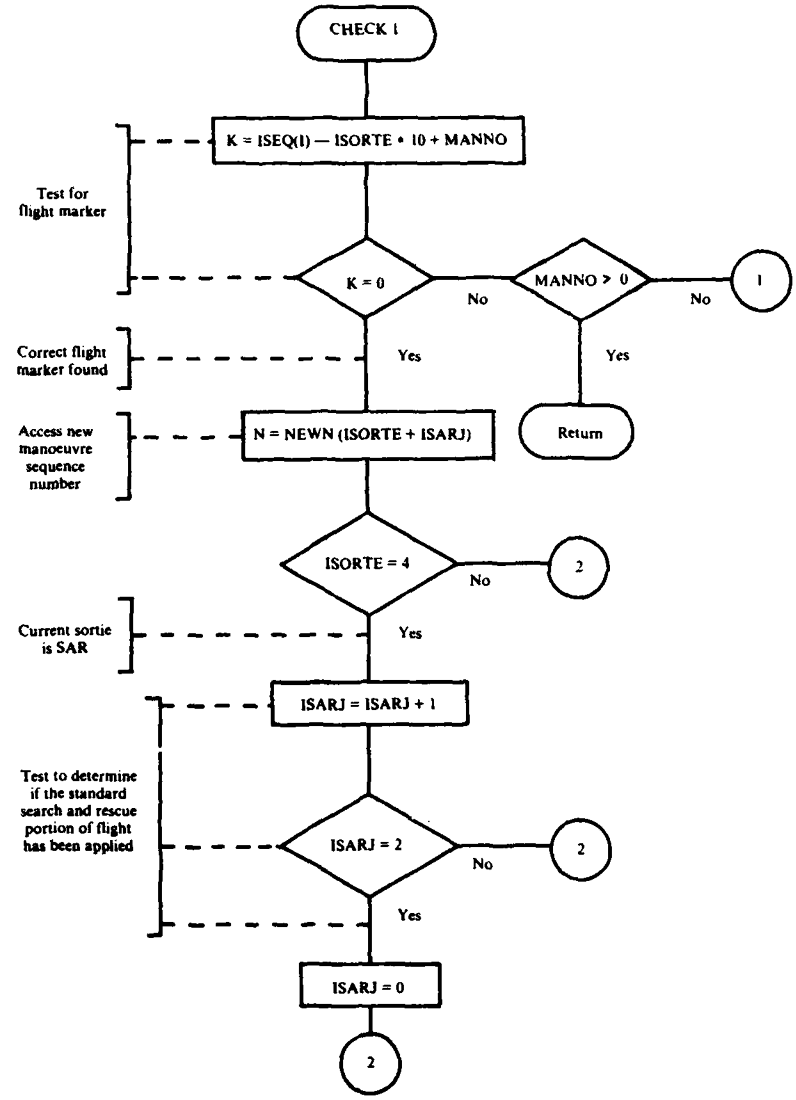

See Table 37 for description of variables

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Fig 10 Routine that identifies the flight markers and skips manoeuvres to form the 0.75 h and 2.25 h flight durations

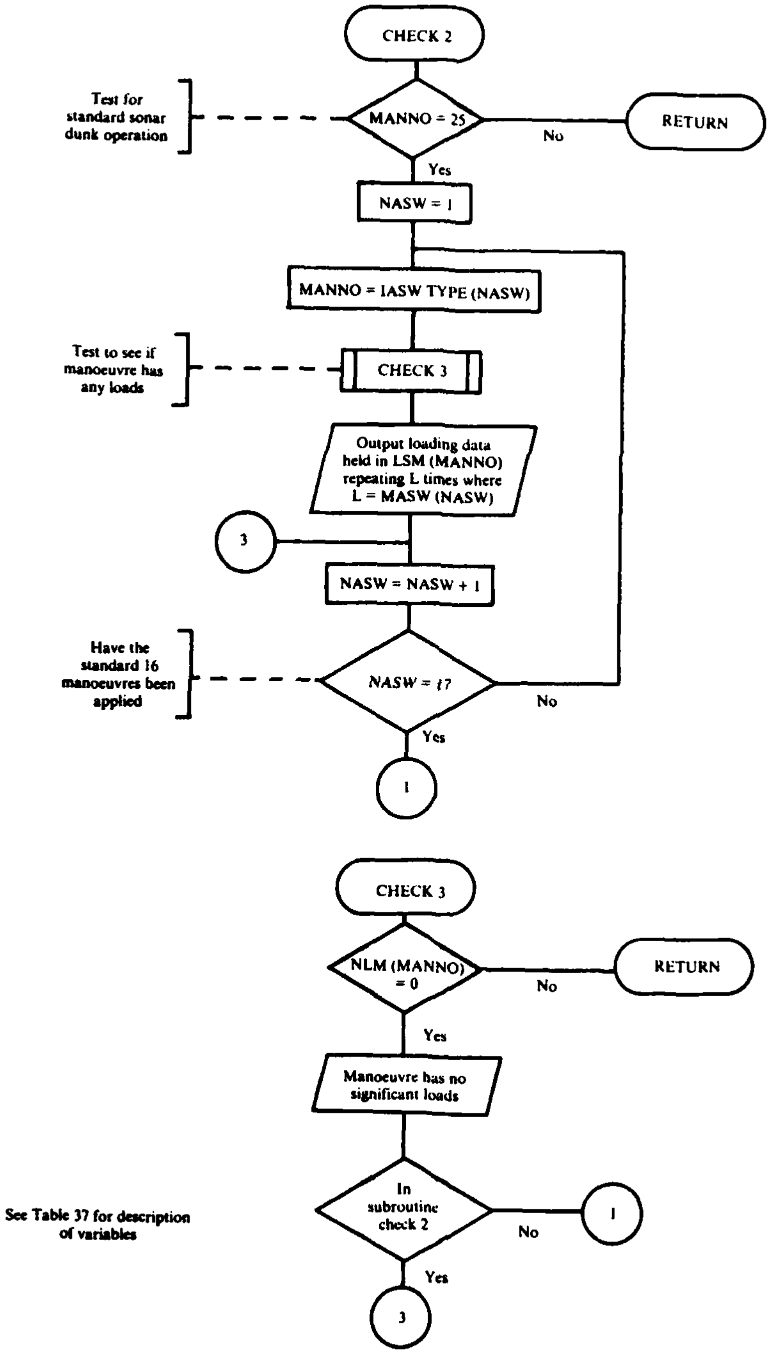

Fig 11 Routines to test for the standard sonar dunk operation and the hover manoeuvre

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REPORT DOCUMENTATION PAGE

Overall security classification of this page

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17. Abstract

Helix and Felix are standard loading sequences which relate to the rotors of helicopters with articulated and semi-rigid rotors respectively. The purpost of the loading standards is, first, to provide a convenient tool for providing fatigue data under realistic loading, which can immediately be compared with data obtained by other organisations. Second, loading standards can be used to provide design data. This Report is the second of the two final project reports and gives the final defined form of the two standards both in full length and shortened versions. The method of generation is extremely simple, although a considerable amount of data is required for the generation algorithm. A FORTRAN program is presented for this purpose, together with complete data tables in the correct format.

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